PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. IV. 1857–58. No. 48.

Seventy-Fifth Session.

Monday, 23d November 1857.

Dr CHRISTISON, V.P., in the Chair.

The following Council were elected:—

President.

Sir T. MAKDOUGALL BRISBANE, Bt., G.C.B.

Vice-Presidents.

Sir D. Brewster, K.H.
Very Rev. Principal Lee.
Right Rev. Bishop Terrot.
Dr Christison.
Dr Alison.
Professor Kelland.

General Secretary,—Professor Forbes.

Secretaries to the Ordinary Meetings,—Dr Gregory, Dr Balfour.

Treasurer,—J. T. Gibson-Craig, Esq.

Curator of Library and Museum,—Dr Douglas Maclagan.

Counsellors.

Dr Maclagan.
Wm. Swan, Esq.
Dr Traill.
Hon. Lord Neaves.
Dr Thomas Anderson.
Rev. Dr Hodson.
Robert Chambers, Esq.
John Russell, Esq.
John Hill Burton, Esq.
David Stevenson, Esq.
Wm. Thos. Thomson, Esq.
Dr Allman.

Monday, 7th December 1857.

At the request of the Council, Dr CHRISTISON, V.P., delivered the following Address from the Chair:—

On this annual occasion of resuming the Ordinary Meetings of the Royal Society, it becomes us, as almost a duty which we owe to science, and to our country, whose science we in some measure represent, that we should review what has been done by the Society during the past year, to merit the position which it holds in public opinion, and the title which it pre-eminently enjoys.

I believe it may be allowed me to congratulate you on the result of such a retrospect of your proceedings. We cannot, indeed, boast of any great or prominent discovery in the physical or natural sciences having been first announced during last Session in this Hall, or first given to the world in our *Transactions* for that period. But in truth, the past year has been nowhere, to my knowledge, marked by any such event in any country. Nay, for several years it has been scarcely possible to place the finger on any great discovery made by the cultivators of natural and physical science in any quarter of the world. We seem to be living in one of those not uncommon pauses in the progress of science, during which discovery, in its grand signification, is at rest, but in which prior discovery undergoes consolidation, extension, and application; and in which a breathing-time is obtained, and a firm vantage-ground whence, without doubt, another advance will be made ere long to other conquests; and the development, possibly, of new elements and new powers,—but certainly of new generalizations and new laws,—will reward the researches of some higher mind, which, without the preparative works of detail of the present day, might remain barren in discovery and invention.

In such unobtrusive, and yet, as we may be permitted to hope, not unproductive labours, this Society may claim to have taken a fair share. Without referring, as might be justly done, to many papers of a more fugitive or less elaborate character which have been produced to our Ordinary Meetings, it will be sufficient for me to call attention to the recent Fasciculus of our *Transactions* for the year

1856–57, in which the mathematician cannot fail to recognise the acute scrutiny, by Mr Boole, of the Application of the Theory of Probabilities to the question of the Combination of Testimonies or Judgments; or the mechanical philosopher to welcome the contributions of Mr Clerk Maxwell to the Theory of Rotation; or the chemist to admire the continuation of Dr Anderson's Analysis of the Products of the Destructive Distillation of Animal Matters; or the naturalist to wonder at the strange and overwhelming variety of forms of microscopic life, to the unfolding of which so much has been contributed by Dr Gregory's elaborate paper on the Diatomaceæ; or the physiologist to applaud and encourage the ingenuity with which a new and promising inquirer, Mr Lister, has successfully investigated the Minute Structure of Involuntary Muscular Fibre.

Nor has the Society neglected other branches of its vocation. I may, in particular, call your attention to what has been done by your Council towards completing the publication of the "Makerstoun Magnetical and Meteorological Observations." These Observations have been already published down to the year 1846, in three extra volumes of the Society's *Transactions;* but as the observations have been continued since that time almost to the present day,—not, indeed, in such number as previously, but with care and regularity, by the direction of our President, Sir T. M. Brisbane,—it was thought that benefit would accrue to science by continuing the reduction and publication of them. This it has been resolved to carry through on a somewhat abridged plan; towards which object the President has munificently contributed L.200, and the Council, on behalf of the Society, has added an equal sum. Mr Welsh of the Kew Observatory, who was himself observer at Makerstoun for a few years, has favoured the Council by superintending the reductions, which are now in progress.

During the past year the Librarian and Council have continued their exertions to bring the Library into a satisfactory and easily accessible condition. Of the sum of L.300 voted by the Society for the purpose, only a small proportion has been expended in the purchase of a few new works,—works, however, of much interest and value. The greater part of the vote has been applied to completing and binding many previously incomplete works, and in adding to the truly valuable Collection of Maps, which was prominently noticed in the introductory Address of Bishop Terrot last year, as having been

begun and advanced far forward, under the kind superintendence of Mr Keith Johnston.

The importance of what has thus been done for the Library, and the value of the collection of books now in the Society's possession, cannot be well appreciated until the publication of the Catalogue, which has been in hand for a longer period than many Members may have thought necessary. It is only those who have been themselves engaged in making a Catalogue that can estimate the time required to carry through such an undertaking well; and to them the time which has been found requisite will not appear too great. When the present Assistant Curator was appointed to his office last year, the Catalogue was actually in type; but in so unsatisfactory a condition, that what had been done may be said to have since been all done over again. During last year it has been almost entirely reconstructed, and much extended; it will be found now, as the Council believe, correct, complete, and worthy of the Society; and it is ready, or nearly so, for publication. The Council, in noticing the completion of this important labour, cannot express too highly the sense they entertain of the services of Dr Lawson, who has applied himself to the task put before him with a zeal, diligence, method, and ability, which lead the Council to congratulate themselves and the Society on the choice which was made in appointing him.

While we may survey, as it appears to me with some satisfaction, these labours of our Society during last session, I will nevertheless take the liberty of observing that, on casting my eye down the List of Fellows which was put before us all, according to custom, at the late annual election of Office-Bearers, it did occur to me to wonder, that so long a catalogue of names, well known in literature and science, should not have produced even more materials for upholding the character and title of the Royal Society of Edinburgh. This list comprises 289 individuals, of whom eighty-nine may be truly considered to be engaged in the pursuit of science, and twenty-four in that of literature; and of the former class there are at least forty-nine, of the latter thirteen, resident in Edinburgh, or not far from it, who have already shown, by their writings and inquiries, that they are well able to maintain and forward the prosperity of literature and science.

I will not pretend to inquire into the causes which, for a few years past, have somehow or another lessened the interest of the

meetings of our Society, in face of such apparently ample resources. But, as one means of counteracting them, I may be permitted to point out to all, but especially to the cultivators of science in our northern land, that they are not perhaps fully aware of the advantages to be derived from promulgating their inquiries and discoveries through the medium of the Society's meetings and published *Proceedings* and *Transactions*. It cannot be too well known to them, that our Prizes, founded through the affection and munificence of the late Sir Alexander Keith and Dr Neill, and of our present President, Sir T. M. Brisbane, are sufficiently numerous to hold out a reasonable prospect of substantial public honours for every successful and important investigation ;—that our printed *Proceedings* and *Transactions*, promptly published, and at once widely disseminated by exchange with every distinguished scientific Society in Europe and America, hold out the temptation of easy and extensive advertisement of discoveries and researches ; and that our Meetings supply, in our audiences, an assemblage of men of talent and weight in every rank and profession, who are competent judges of ability, and whose good opinion will ever tend to foster, advance, and reward true merit, especially among the young and aspiring in science. I could mention not a few instances in my own time of men of celebrity, whose first successful step in life rested on the fame acquired for them among the Fellows of this Society by a paper read at its Ordinary Meetings.

But there is also a whole galaxy of names in our list, of men in need of no such encouragement, who pursue science for its own sake alone, and yet who choose other channels than this Society for promulgating their successes. These I beg simply to remind that the Royal Society is no longer the tedious channel, whose former tardiness has probably led to a falling off in the number of important communications to our Meetings; and farther, that the production of a paper here does not prevent its author from selecting any other medium of communication which he may prefer to our *Transactions*.

In making the survey which has led to these, I trust, neither unseasonable nor unreasonable considerations, my attention has been naturally turned to the changes which the lapse of a short year has created in our List of Fellows. Of the Ordinary Fellows, as the list stood last year, nine have died, and one has resigned. The ordi-

nary list includes 269 Fellows. The newly-elected Fellows are *Horatio Ross, Esq., Dr James Black, Dr John Ivor Murray, The Right Hon. John Melville, Lord Provost, John Blackwood, Esq., Brinsley de Courcy Nixon, Esq., Andrew Murray, Esq., W.S., Rev. Dr Macfarlane, Duddingston, Dr W. M. Buchanan*, and *Thomas Login, Esq., C.E.* Our loss has therefore been exactly replaced, so far as mere number is concerned.

Whether our loss has been replaced in other respects than in mere numbers, is a question which the future only can answer. But if our new members are to take upon themselves the duty of repairing in all respects the casualties of the last twelve months, they have an arduous task before them ; for, among our losses, we have to deplore the deaths of *William Henry Playfair, William Scoresby, Marshall Hall*, and *John Fleming*,—names, than which we can scarcely point to any in the British Islands more estimable in their respective sciences of Architecture, Navigation, Physiology, and Natural History.

In one respect these gentlemen have had a common fate. They have all attained to an advanced age,—dying, except partially in one instance, in the pride of mental vigour, but yet not until each had left behind him works that are likely to be imperishable, so far as the work of man may be so. This consideration casts a ray of sunshine over our gloom of regret at their disappearance from amongst us. But it cannot render our calamity less material, and must only increase our anxiety that their places here may be worthily and speedily filled from the succeeding generations of members.

The other deceased fellows whom I have to mention are *Mr John Dewar*, advocate, *Mr Bald*, civil engineer in London, *Mr John Haldane* of Haddington, *Mr George Forbes*, banker in this city, and *Mr John Adie*, optician in Edinburgh. Of these *Mr Haldane* was known to us as an unobtrusive amateur in natural history, to which he was naturally enough attracted during his long service in earlier life, as an able officer of the Hudson's Bay Company in North America. *Mr Forbes*, one of a family long remarkable in our city for worth and talent, and still represented now more ably than ever in this Society, was for some years our faithful and zealous Treasurer ; and was endeared to many of us as a gentleman of cultivated taste in literature and art, and to the whole community as a man of most amiable disposition, constantly abounding in works of active practical benevolence. *Mr Adie's* enrolment among us is sufficient proof

that he successfully followed his calling as one of the scientific arts; and by those by whom he must be better appreciated than by myself, he was greatly esteemed as a man conversant with the highest branches of his profession, and who has left behind him in that respect scarcely an equal, certainly no superior, in Edinburgh, or perhaps even in London itself.

The four pre-eminent men whose names I mentioned in the first instance, demand from us much more than a simple passing notice. I wish that I were competent, and your present leisure sufficient, for the full biography which is necessary to do them complete justice. I am sure, however, that you will welcome some present short tribute of respect to their memory; and that you will excuse my shortcomings on a field of great extent, which I have had unfortunately but very brief opportunities of leisure to survey, and on which, indeed, I should on that account have been compelled to decline entering, had it not been for the kindness of sundry Members of Council who have furnished me with the necessary means.

William Henry Playfair, a Scotchman by descent, and a citizen of Edinburgh from his youth, was born in London, where his father, the brother of our former Professor, Philosopher, and Secretary, John Playfair, practised as an architect of repute. Educated here under the eye of his uncle, and living much in the society of a host of his uncle's pupils, comprising a multitude of young men of talent, who have since risen to great eminence in many departments of human knowledge, Mr Playfair acquired an extensive acquaintance with Learning, Science, and Art, and above all, in his own profession, a correct and fastidious taste, of which we now reap the fruits in this city.

At the early age of twenty-six Mr Playfair was chosen by His Majesty George the Third's Commissioners to carry out the erection of the buildings for the University,—his first great work, in which he was at one and the same time aided by the general grandeur, and cramped by the faulty details, of his precursor Adam,—and in which he ultimately triumphed over every difficulty. There is nothing in our northern metropolis to compare with the simple stateliness and chaste details of the interior quadrangle of the University,—which is mainly Playfair's own,—for his predecessor contemplated the monstrous and fatal blot of a double quadrangle, with differently elevated courts;—and we have nowhere else any single apartment that com-

bines so chastely and harmoniously the vastness of space, architectural splendour, and bibliothecal fitness of the upper Library Hall.

It would be out of place for me to notice here all Playfair's public works; which have been principally erected in Edinburgh, constitute a large proportion of the most conspicuous architectural decorations of the city, and bid fair to immortalize him, so long as the capital of Scotland shall continue to attract, as it does now, visitors of taste from all quarters of Europe and America. Among critics in architecture it may be wished that some of them were better. But was it the architect's fault that they are not so? In every one of his works, except Donaldson's Hospital, he had to encounter great difficulties of site, or neighbourhood, or both together,—difficulties, indeed, sometimes unconquerable by any skill. And yet even in these, when he is said to have failed, the critics who think so appear to me to proceed for the most part upon the assumption, that he had within his choice plans of far greater magnitude than his limits, and a command of means far beyond his actual treasury. Who, for instance, can say what might not have been the felicity of an architect, so pure in his style, and so fruitful in his resources, had he been told when he designed the columned temple in a portion of which our Society is now accommodated, that he was afterwards to cover the Mound, from the bottom to the crown of its slope, with public edifices?—and that he was at liberty to do so at a cost of twice, thrice, or four times the L.100,000 which have been actually expended on them?—for that seems conditional to the criticisms to which one often hears Playfair subjected, on account of his designs for the Royal Institution's Building, the National Gallery, and the Free Church College.

Of all his works none has called forth such unqualified applause as Donaldson's Hospital; and his success there was all the more remarkable, because the style was altogether new to him. This has been described by one of his most successful ephemeral biographers, —plainly a zealous, yet impartial, and able admirer,—as a type of Gothic style; for which the author is obliged to admit, with evident compunction, the unhappy cognomen of "Debased Gothic." But let us call this work of Playfair's hands more fitly the "Inhabitable Gothic;" and no one has been more perfectly successful in making the Gothic habitable than our deceased fellow-member. No pleasure however is without alloy. There are few who will not regret that

so magnificent a pile had not been destined for a more conformable object. Scotchmen were usually charged in former days by their neighbours with presenting, by a species of elective attraction, the frequent union of poverty and pride. It may be allowable in a native of the Scotch metropolis to lament, that the old sneer should be verified in these present times, by the pride of lodging poverty in such a palace.

I am assured that Playfair was so conscientiously fastidious in discharging the trust reposed in him as a professional man, that he executed all his drawings with his own hands. When engaged in this task, he for many years constantly worked in the standing posture, often for twelve hours a-day. To this habit he himself ascribed, not without justice, a paralytic affection of the spine, which gradually stole upon him when he was a man of middle life only. Slowly increasing year after year, it at last prevented in a great measure locomotion. But his aptitude for exercise of the mind continued unimpaired long afterwards. And even when his sad malady, spreading upwards, enfeebled his arms, and at length invaded also his mental faculties, it only required a new point in his plans to need consideration, when he was aroused to his old perspicuity and decision, and the point was settled.

Playfair was, in every good sense of the words, a scholar and a gentleman. As such, his society was courted on all hands. But for many years his infirmities had withdrawn him very much from the social circle; so that few except one or two old intimates can now tell how much society has lost in this respect by his death. He died in his sixty-eighth year. No one can doubt that his memory will long survive in his works.

The biography of *William Scoresby* belongs not so much to us as to the parent Society of the sister kingdom. But as this remarkable man frequently visited us, joined us as an Ordinary Fellow, sometimes contributed to the business of our meetings, and was in early life a student of our University during the winter intervals of repose from his voyages of Arctic adventure, it becomes me to advert shortly to the departure of one so eminent in Science, so amiable in disposition, so distinguished for Christian virtue.

Scoresby was the son of an experienced whaler and able navigator of Whitby, in Yorkshire. The father's zeal in his profession was so intense and catholic, that he actually carried off his child to his

favourite Arctic regions at the age of ten, without the previous knowledge of Mrs Scoresby,—an attached wife, and no less fond a mother. The idea, it must be added, did not occur to the father till he one day detected, with much trouble, the urchin hidden below in the Resolution, while the "Blue Peter" was flying from the mast-head, and when the boy had a clear intention of running away from home in this remarkable manner. Entering thus early on a life of fearless adventure, it is no wonder that the second Scoresby outstripped the first in eminence as a navigator. At the age of sixteen, he discovered with his father an open sea near Spitzbergen, apparently stretching towards the North Pole; and he actually sailed in it to the latitude of 78° 46′,—the highest known to have been ever attained up to that time. At the age of twenty-one he succeeded his father as commander of the Resolution whaler of Whitby; and for twelve years afterwards he annually fished the Greenland Seas, carrying on at the same time constant researches in geography, magnetism, geology, and zoology; for which he had prepared himself by several winters of study under Jameson and other Professors of the University of Edinburgh. The results were published in his "Account of the Arctic Regions," and in his "Voyage to the Northern Whale Fishery."

A deep pure vein of piety, fostered by careful early training on the part of his parents, everywhere pervaded his pursuits, whether professional or scientific. No whale was hunted, and no other work that could be dispensed with was done, by the crew of the Resolution on the Sabbath. Their captain was constantly as assiduous in maintaining the religious condition of his men, as in preserving their health, and availing himself of their seamanship. But it is also recorded of him, that he generally contrived to reward the forbearance of his men while their game was sporting securely on all sides around them on Sunday, by ensuring that they should make prize of a whale or two at the first entrance of the hours upon Monday morning.

The depth and sincerity of his feelings, as a responsible creature, he has recorded in his "Sabbaths in the Arctic Regions." The ultimate consequence of his following this bent of his mind was, that, while still in the prime of life and vigour, he deserted his favourite the sea, studied at Cambridge for the English Church, took soon

afterwards the degree of Doctor of Divinity, and became a zealous and efficient member of the ministry, first among his co-mates as Chaplain to the Mariner's Church at Liverpool, and eventually at Bradford, as pastor of an extensive manufacturing population.

The ardent and conscientious discharge of his religious duties, however, did not prevent him from applying also to the favourite scientific pursuits of his youth. Only a year before his death, indeed, he undertook a voyage to Australia, for the purpose of testing his theory respecting the aberration of the compass in iron ships ; and one of his last scientific observations was the measurement of the ocean wave in a storm off the Cape of Good Hope, when he ascertained that the elevation of the highest, when the sea "ran mountains high," was forty feet from trough to crest.

I cannot, consistently with the indispensable brevity of this sketch, even so much as enumerate Dr Scoresby's many contributions to science ; but must hasten at once to the close of this theme. Scoresby died, after a tedious illness, at a fair old age, in his 68th year. Few men can at that age console themselves with the retrospect of so long an existence so usefully spent. The intrepid seaman, the skilful navigator, the philosopher of no mean order, and the pious divine, was throughout his entire life full of good works in each and all of his multifarious vocations.

The connection of *Marshall Hall* with our Society has been somewhat similar to that of the Arctic Navigator. Born in Nottinghamshire, and trained there till his 19th year, he then came to this city in 1809 to pursue the study of medicine. He graduated at our University in 1812 ; remained two years longer as one of the resident physicians of the Royal Infirmary ; was elected during that period President of the Royal Medical Society, an office which has generally been the forerunner and presage of future distinction ; delivered, it seems, a short course of lectures on the Diagnosis of Diseases, ever afterwards a favourite subject of inquiry with him ; and on leaving this, to settle as a physician in Nottingham, continued to maintain his predilection for Edinburgh, as is shown by his having joined its Royal Society as a Fellow in 1819. But this has been the full amount of his connection with us.

He had been scarcely twelve years in Nottingham, when the promptings of genius induced him to seek a fitter field for its de-

velopment in London, where he slowly attained a respectable place as a physician. His contributions to the practice of his profession, both before and after he settled in London, were numerous, always ingenious, often original, generally valuable, but sometimes controvertible. Of all these contributions none perhaps will convey a higher idea of his acute and inventive discrimination as a physician, than his inquiry, begun in 1824, and perfected some years afterwards, into the constitutional effects of the loss of blood, of which he successfully investigated the phenomena, supplied the explanation, and detailed the conclusions, in the shape of valuable instruction, for distinguishing between inflammation and nervous irritation, thereby laying down the means of escape from fearful errors at that time often committed by the incautious and uncompromising admirers of blood-letting as a remedy.

But the credit, which may be justly claimed for Marshall Hall for his contributions to medical experience and practice, sinks into insignificance when compared with his higher fame as a physiologist. It belongs properly to the sister Royal Society to sketch biographically the details of his discoveries in physiology. From me they can receive but a brief and passing notice, without too great a demand on your time and attention. I must confine myself, indeed, to only one of them, but that the greatest of all, the precursor and foundation of all the rest, and sufficient of itself to stamp Marshall Hall as an inventive genius, whose name will go down to posterity as one of the pillars of physiological science in the present century.

It is evident from his works that Marshall Hall's attention had been eagerly turned to the immortal discoveries of our greatest Scottish physiologist in these recent times, the late Sir Charles Bell, in regard to the functions of the brain, spinal marrow, and nerves. From that moment the nervous system was his great centre of attraction. Sir Charles first sighted, and laid down in an undeniable shape, the grand fact in the physiology of the nervous system, that sensation is conveyed and motion governed by different nerves, or different filaments of nerves, having different origins in the cerebro-spinal system. Hall, however, was the first to see that this separation of what were once conceived to be common functions of all, or almost all, nerves, was not enough to account for the whole

phenomena of nervous action. He showed that, sensation being conveyed from the circumference to the centre, the brain, by one set of nerves, or filaments of nerves,—as Sir Charles first indicated,—and motion being excited by volition sending an influence from the centre to the circumference by means of other nerves or nervous filaments,—also a branch of Bell's discoveries,—there is another class of actions caused, independently of volition or of consciousness, by external impressions made directly on the spinal marrow itself; and, above all, that there is another set of numberless mysterious movements and actions, mysterious formerly,—but intelligible and clear as noon-day since his inquiries have been accepted,—which are excited by an agency, conveyed first from the circumference along *afferent* filaments of nerves to the spinal marrow as their centre, and thence along other or *efferent* nervous filaments to the circumference where action is eventually manifested, and all this independently of volition, often too of sensation, and not unfrequently of consciousness. These actions, which are constantly illustrated in the exercise of our functions, such as in the acts of breathing, swallowing, discharging the excretions, sneezing, coughing, winking, and the like, constitute what are called by Hall *Reflex Actions.* They are also exemplified by a thousand phenomena occurring during disease. Let me instance one example, which will at once render his discovery of Reflex Actions intelligible to any common understanding. When in poisoning with prussic acid, the sufferer is perfectly insensible and motionless, and no muscular action is discoverable except a spasmodic upturning of the eyeballs, and a slow, short, imperfect respiration,—if we pour upon the head suddenly a full stream of cold water, instantly a deep inspiration is drawn, which fills the whole chest. By repeating this process, we remove several of the immediate and sure causes of death, and may restore consciousness, sensibility, and at last perfect health. But this by the bye; the main purpose in quoting the fact now is to exemplify an action caused by an impression on a part of the nervous circumference, conveyed by certain nervous filaments to the spinal marrow, and transmitted instantly by certain other nervous filaments to the muscles which maintain respiration,—and quite independently of volition, of sensation, of consciousness, of all the cerebral functions in short, which, in the case supposed, are totally

dormant and suspended. This is a reflex action, one of a countless multitude of phenomena which were entirely, or almost altogether, misunderstood until Marshall Hall caught the first glimpse of them, investigated, elucidated, and classified them, and deduced innumerable conclusions from them for explaining previously incomprehensible phenomena occurring in health, and still more in disease. This is the grand fact, the discovery of which we owe to Marshall Hall, and from which he afterwards proceeded to further discoveries in the physiology of the nervous system.

Like other discoverers, he at first encountered much opposition to his new views. But all physiologists and physicians are now agreed in adopting the most important of them, and in acknowledging the obligations which physiology and medical practice owe to him. For many of the latter years of his life, he was esteemed as one of the most successful physiological inquirers in Europe. He persevered in his researches till near the end of his life, which terminated in a slow and painful illness before the close of his 67th year.

It still remains for me to take notice of one other loss which the Society and science have sustained, and a loss which, to us in particular, is the most serious which the last twelve months have brought forth. By the death of *Dr John Fleming*, the Royal Society has lost not only a man well known to science, but likewise one of its most useful and active members. He may be said to have been the last survivor of a group of naturalists who gave lustre to Scotland soon after the commencement of the present century.

John Fleming was born at Bathgate in 1785. Having chosen the Church for his profession, and having been settled at an early age as a minister of the Church of Scotland, in the charge of the parish of Bressay, in Shetland, his first writings as a naturalist consisted of observations which he made on the zoology and geology of that interesting group of islands. Papers were read by him to the Wernerian Society of this city, so early as 1808, when he was only twenty-three years of age, on the Narwhal, and on the Rocks of Papa Stour. Being translated soon afterwards to the parish of Flisk, on the south shore of the Frith of Tay, he had fresh materials around him for pursuing his favourite researches, and made ample use of them for cultivating various branches of Natural History. Several of the most interesting districts of his neighbourhood, such as St

Andrews and the Red Head, were first geologically described by Fleming.

Gradually, however, his attention during the hours he could spare from his professional duties became concentrated in the study of animals; and the results appeared in 1822 in his "Philosophy of Zoology," a laborious and still most serviceable work, which instantly obtained for him a high reputation as a philosophical naturalist. This was followed by another work of equal labour, "On British Animals," in which he exhibited their descriptive characters. Fleming also contributed to the *Encyclopædia Britannica* some important papers on sections of the Animal Kingdom, particularly one on the Mollusca.

Throughout these and all his other labours as a man of science, our departed associate never ceased to sustain his earnest and conscientious character as a minister of the Gospel. It is stated of him that, on being translated in 1832, from comparatively light duty at Flisk to the parish of Clackmannan, where he had pastoral charge of a populous flock, he deliberately locked up his cabinets, until familiarity with his duties should enable him to open them at a more convenient season.

In 1834 he was relieved altogether from his labours as a minister of the Word, by accepting the chair of Natural Philosophy in King's College, Aberdeen. It is to be regretted that a more congenial position in a University did not at this time open to him; for, in a chair of Natural History, he could not have failed to confer lustre both upon himself and upon his University; whereas, in a chair of Physics, entered on not till the 45th year of his age, he never could have risen beyond the level of a diligent teacher. At length a more suitable position was attained by him in 1845, when he undertook the Professorship of Natural Science in the Free Church College of Edinburgh. Here his object more especially was to give the future pastors of the Free Church a general acquaintance with Natural Science, so as to prepare them in some measure for the discussion of the various questions on which it is now so frequently brought in contact with religion. It is generally acknowledged, that in this field of exertion, Dr Fleming proved of the greatest utility to the communion of which he was the ornament. He had that object always much at heart, and when assured that his chair

would probably be maintained in perpetuity, he declared that he felt as if a kind of dew had fallen upon him, invigorating his aged frame to increased activity.

Notwithstanding the comprehensive nature of his "Philosophy of Zoology," it will probably be generally admitted, that Dr Fleming's great merit as a man of science lay in his careful and vigilant power of observation. His knowledge of rocks, of fossils, and of living species, was no less extensive than exact. It was perhaps in some measure his profound and ever active sense of what was necessary for the faithful observation of a fact, which made him distrustful beyond rule of what was reported by others. Caution, carried to such a degree as to amount to a scientific scepticism in receiving the testimony of others, exercises eventually a baneful influence on the fruits of the mind that thus indulges in it; for the benefit is thereby lost of much that has been tolerably well ascertained by other inquirers, and conclusions are apt to be pertinaciously opposed long after the world of science has generally considered them as settled. It may be doubted whether Dr Fleming did not sometimes incur this misfortune. Yet, while he was engaged in disputing evidence and battling off inductions, even those who might think him unreasonable were forced to acknowledge, and even to admire, his extraordinary shrewdness, and the philosophic caution by which he was prompted in every movement of his own mind.

It is understood that Dr Fleming had prepared a new work on the Geology of the Environs of Edinburgh, a subject always of deep interest, and on which few men were so well entitled to speak. Of this work it is gratifying to learn that a large portion has already been put through the press.

For this short sketch of his scientific life, I am principally indebted to our fellow-member, Mr Chambers. For some months at least before his death, Dr Fleming had been observed by his friends to fail in looks and strength, owing to some obscure disturbance of the digestive organs. At last, and when no apprehensions were entertained of so sudden a termination to his life of usefulness, he was seized abruptly with violent illness, which proved to be owing to perforation of the stomach, and which ended fatally next morning, only fifteen days ago.

With this imperfect tribute to his memory, I bring to a conclu-

sion what may be fairly stated from this chair regarding one whose communications to our meetings were numerous, singularly lucid, and always received with marked attention ; whose criticisms invariably restored animation when our interest threatened to flag ; and whose strictures, if they sometimes cut rather deep, never failed to strike out new ideas from any adversary who was worthy of his lance. It is in these capacities that we who are now here assembled will long fondly recall him, and lament his removal from our circle, and feel that it will be hard to supply his place.

The following Communication was read :—

Excursions in the Troad, with observations on its Topography and Antiquities. Part I. By Dr William Robertson, F.R.C.P. Communicated by Dr J. Y. Simpson.

The following Candidates were elected Ordinary Fellows :—

Dr Williamson, of Leith, F.R.C.S. Ed.
Dr Malcolm, F.R.C.P. Ed.
Dr James Duncan, F.R.C.S. Eng. and Ed.

The following Donations to the Library were announced :—

Scheikundige Verhandelingen en Onderzoekingen door G. J. Mulder. Eerste Deele. Rotterdam, 1857. 8vo.—*From the Dutch Government.*

List of Members of the Institute of Actuaries. 8vo.—*From the Institute.*

Letter to Lord Viscount Palmerston on Medical Reform. By John G. M. Burt. Edinburgh, 1857. 8vo.—*From the Author.*

Collection of Admiralty Charts, and relative Lists, and other Documents. *From the Lords of Admiralty.*

Proceedings of the Berwickshire Naturalists' Club. Vol. iv., Part 1. 8vo.—*From the Club.*

Notices of the Meetings of the Members of the Royal Institution of Great Britain. Part 7. 8vo.—*From the Society.*

Transactions of the Historic Society of Lancashire and Cheshire. Vol. ix. London, 1857. 8vo.

Charts of Track-Survey of the Rivers Salado, Parana, and Colastiné. By Commander Thomas J. Page, U.S.S. Water Witch. 1855. —*From the Author.*

Annalen der Königlichen Sternwarte bei Münich. Band ix. 8vo.—*From the Observatory.*

Fortschritte der Physik. Jahr 1847, zweite abtheilung; 1853; 1854. Berlin. 8vo.—*From the Physical Society, Berlin.*

Proceedings of the Royal Astronomical Society. Vol. xvii., No. 9. 8vo.—*From the Society.*

Resultate aus den an der Königl. Sternwarte veranstalteten meteorologischen Untersuchungen, nebst Andentungen über den Einfluss des Clima von München auf die Gesundheits-Verhältnisse der Bewohner. Von Dr J. Lamont. München, 1857. 4to.—*From the Observatory.*

Catalogue of the New York State Library. 2 vols. Albany, 1856. 8vo.—*From the State.*

Documents relative to the Colonial History of the State of New York, procured in Holland, England, and France, by John Romeyn Brodhead. Edited by E. B. O'Callaghan, M.D. Vols. v., vi., and ix. Albany, 1855. 4to.—*From the American Geographical and Statistical Society.*

Proceedings of the Academy of Natural Sciences of Philadelphia for 1856–7. 8vo.—*From the Academy.*

Proceedings of the American Philosophical Society. Vol. vi., No. 56. 8vo.—*From the Society.*

Transactions of the American Philosophical Society. New Series. Vol. ii., Part 1. Philadelphia, 1857. 4to.—*From the Society.*

Reports of the Commissioners of Patents for 1855. 8vo.—*From the American Geographical and Statistical Society.*

First Annual Report on the Improvement of the Central Park, New York. New York, 1857. 8vo.—*From the same Society.*

Memoirs of the American Academy of Arts and Sciences. New Series. Vol. vi., Part 1. Cambridge and Boston, 1857. 4to.—*From the Society.*

Smithsonian Contributions to Knowledge. Vol. ix. Washington, 1857. 4to.—*From the Smithsonian Institution.*

Report on Insanity and Idiocy in Massachusetts. By the Commission of Lunacy. Boston, 1855. 8vo.—*From the American Statistical Society.*

Report of the Superintendent of the Coast Survey, showing the progress of the Survey during the year 1855. Washington, 1856. 4to.—*From Professor Bache.*

Quarterly Return of the Births, Deaths, and Marriages registered in the Divisions, Counties, and Districts of Scotland. Quarters ending 31st March 1857, 30th June 1857, and 30th September 1857. 8vo.—*From the Registrar-General.*

Calcul Decidouzinal par M. le Baron Silvio Ferrari; traduction sur l'original Italien. Turin, 1857. 4to.—*From the Author.*

Magnetische Ortsbestimmungen ausgeführt an verschiedenen Puncten des Königreichs Bayern und an einigen auswärtigen Stationen. Von Dr J. Lamont. 2 Theil. Munchen, 1856. 8vo.—*From the Author.*

Specimen of Tables, calculated and stereomoulded by the Swedish Calculating Machine of George and Edward Scheutz. London, 1857. 8vo.—*From the Authors.*

Report of Council read at the Annual General Meeting, held 4th May 1857, of the Royal Institute of British Architects. 4to, —*From the Institute.*

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt. Nos. 2, 3. Wien, 1856.—*From the Institute.*

Quarterly Journal of Agriculture and Transactions of the Highland and Agricultural Society of Scotland. July and October 1857. —*From the Society.*

Transactions of the Linnean Society of London. Vol. xxii. Part 1. London, 1856. 4to.—*From the Society.*

American Journal of Science and Arts, conducted by Professors Silliman and Dana. May and September 1857.—*From the Editors.*

Resumen de Los Trabajos Meteorologicos correspondientes al año 1854, verificados en el Real Observatorio de Madrid bajo la direccion de D. Manuel Rico y Sinobas. Madrid, 1857. 4to.—*From the Observatory.*

Comte-Rendu Annuel adresse a s. exc. M. De Brock, Ministre des Finances, par le Directeur de l'Observatoire Physique Central, A. T. Kuppfer. Annee 1855. St Petersburg, 1856. 4to.—*From the Observatory.*

Assurance Magazine and Journal of the Institute of Actuaries. July and October 1857. 8vo.—*From the Institute.*

Descriptions of four new species of Unios, &c. By Isaac Lea, LL.D. Philadelphia, 1857. 8vo.—*From the Author.*

Report of the Secretary of War, communicating Colonel Graham's Report of the Harbours, &c., in Wisconsin, Illinois, Indiana, and Michigan. Washington, 1856. 8vo.—*From the Secretary of War, U.S.*

Statistical Report on the Sickness and Mortality in the Army of the United States, compiled from the Records of the Surgeon General's Office ; embracing a period of sixteen years, from January 1839 to January 1855. By Richard H. Coolidge, M.D. Washington, 1856. 4to.—*From the Surgeon-General, U.S. Army.*

Astronomische Beobachtungen auf der Königlichen Univeristäts Sternwarte zu Königsberg. Sieben und zwanzigste, acht und zwanzigste und dreissigste Abtheil. Königsberg, 1856. 8vo.—*From the Observatory.*

Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen. Afdeeling Natuurkunde, vijfde Deel, tweede und derde Stuk ; zesde deel, eerst, tweede, und derde Stuk. Afdeeling Letterkunde, tweede Deel, tweede, derde, und vierde Stuk. Amsterdam, 1856–57. 8vo.—*From the Academy.*

Octaviæ Querela. Carmen cujus auctori Johanni van Leeuwen, e Vico Zegwaart, certaminis poetici præmium secundum e legato Jacobi Henrici Hoeufft adjudicatum est in consessu publico Academiæ Regiæ Scientiarum, die 9m. Martii anni 1857. Amstelodami, 1857. 8vo.—*From the Academy.*

Report of the Geological Survey in Kentucky, made during the years 1854 and 1855. By David Dale Owen. Frankfort, Kentucky, 1856. 8vo.—*From the Smithsonian Institution.*

Report of the Commissioners of Patents for the year 1855. Agriculture, Arts, and Manufactures. Washington, U.S., 1856. 8vo.—*From the U.S. Patent Office.*

Report of the Secretary of State on the Criminal Statistics of the State of New York. Albany, 1855. 8vo.—*From the State.*

Annual Report of the Commissioners of Emigration of the State of New York, for the year ending 31st December 1856. New York, 1856. 8vo.—*From the State.*

Annual Report of the Canal Commissioners of the State of New York, for 1854. Albany, 1855. 8vo.—*From the State.*

Report of the Joint Special Committees of the Chamber of Commerce, and American Geographical and Statistical Society, on

the extension of the decimal system to Weights and Measures of the United States. New York, 1857.—*From the American Statistical Society.*

Annual Report of the Secretary of State, relative to Statistics of the Poor of New York. Albany, 1855. 8vo.—*From the State.*

On the Statistics and Geography of the Production of Iron. By Abram S. Hewitt. New York, 1856. 8vo.—*From the American Geographical and Statistical Society.*

Report of the State Engineer and Surveyor on the Canals of the State of New York, for 1854. Albany, 1855. 8vo.—*From the State.*

Bulletin of the American Geographical and Statistical Society. Vol. ii. New York, 1857. 8vo.—*From the Society.*

The Growth of Cities. By Henry P. Tappan, D.D. New York, 1855. 8vo.—*From the New York Geographical Society.*

Eighth Annual Report of the Governors of the Alms House, New York, for the year 1856. New York, 1857. 8vo.—*From the Governors.*

Access to an open Polar Sea, in connection with the search after Sir John Franklin, and his Companions. By E. K. Kane, M.D. New York, 1853. 8vo.—*From the American Geographical and Statistical Society.*

Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1856. Washington, 1857. 8vo.—*From the Institution.*

An Account of the Smithsonian Institution, its Founder, Building, Operations, &c. By William J. Rhees. Washington, 1857. 8vo.—*From the Smithsonian Institution.*

The Transactions of the Academy of Science of St Louis. Vol. i. St Louis, 1857. 8vo.—*From the Academy.*

Annual Reports of the Board of Agriculture of the State of Ohio, for the years 1850, 1851, 1852, 1853, 1855. 8vo.—*From the State of Ohio.*

On the New Red Sandstone Formation of Pennsylvania, &c. By Isaac Lea, LL.D. Philadelphia, 1856. 8vo.—*From the Author.*

Archæologia; or, Miscellaneous Tracts, relating to Antiquity, published by the Society of Antiquaries, London. Vol. xxxvi.

Part 2, and Vol. xxxvii., Part 1. London, 1857, 4to.—*From the Society.*

Proceedings of the Boston Society of Natural History. 1856–7. 8vo.—*From the Society.*

Nova Acta Regiæ Societatis Scientiarum Upsalensis. Seriei tertiæ, Vol. i. Fasc. 1 et 2; Vol. ii., Fasc. 1. Upsal 1855–6. 4to. —*From the Society.*

Mémoires Couronnés et Mémoires des Savants Étrangers, publies par l'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique. Tomes xxvi., xxvii., xxviii. Bruxelles, 1855–6. 4to.—*From the Academy.*

Mémoires de l'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique. Tome xxx. Bruxelles, 1857. 4to.—*From the Academy.*

Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscou. Tome x. Moscou, 1855. 4to.—*From the Society.*

Astronomical Observations made at the Royal Observatory, Edinburgh. By Charles Piazzi Smyth, F.R.SS.L. and E. Vol. xi. for 1849–54. Edinburgh, 1857. 4to.—*From the Observatory.*

Report on the Adjudication of the Copley, Rumford, and Royal Medals; and appointment of the Bakerian, Croonian, and Fairchild Lectures, compiled from the original Documents in the Archives of the Royal Society. By James Hudson. London, 1834. 4to.—*From the Society.*

Six Discourses delivered before the Royal Society at their Anniversary Meetings, on the award of the Royal and Copley Medals; preceded by an Address to the Society on the progress and prospects of Science, by Sir Humphry Davy, Bart. London, 1827. 4to.—*From the Society.*

Mémoires de l'Académie Impériale des Sciences de St Petersburg. Sixieme Serie. Sciences Naturelles, Tome vii.; Sciences Politiques, Histoire, Philologie, Tome viii. St Petersbourg, 1855. 4to.—*From the Academy.*

Mémoires Présentés a l'Académie Impériale des Sciences de St Petersbourg par divers Savants et lus dans ses Assemblees. Tome vii. St Petersbourg, 1854. 4to.

Annuaire de l'Académie Royale des Sciences, des Lettres, et des

Beaux-Arts de Belgique, 1856, 1857. Bruxelles, 12mo.—*From the Academy.*

Almanach der Kaiserlichen Akademie der Wissenschaften. Siebenter Jahrgang, 1857. Wien. 8vo.—*From the Vienna Academy.*

Astronomical and Meteorological Observations made at the Radcliffe Observatory, Oxford, in the year 1855, under the superintendence of Manuel J. Johnston, M.A., Radcliffe Observer. Vol. xvi. Oxford, 1856. 8vo.—*From the Observatory.*

Journal of the Asiatic Society, 1856, No. 6; 1857, Nos. 1, 2, and 3. Calcutta. 8vo.—*From the Society.*

Étioles Filantes. Télégraphe Électrique. Phénomènes periodique. Par A. Quetelet. 8vo.—*From the Author.*

Rapport adressé a M. le Ministre de l'Interieur, sur l'Etat et les Travaux de l'Observatoire Royale, pendant l'année 1856; par le Directeur A. Quetelet.—*From the Author.*

Proceedings of the Royal Astronomical Society. Vol. xvii., Nos. 4–7.—*From the Society.*

Des Observatoires du Nord de l'Allemagne et de la Hollande et du Magnétisme Terrestre dans ces deux Contrees. Par Ernest Quetelet. 8vo.—*From the Author.*

Rapport de M. Ad. Quetelet sur une Memoire concernant l'etat actuel des lignes isoclimiques et isodynamiques dans la Grande Bretagne, la Hollande, la Belgique et la France, d'après les Observations de l'auteur M. Mahmoud-Effendi, Astronome Egyptien. 8vo.—*From M. Quetelet.*

Proceedings of the Society of Antiquaries of London. Vol. iii., Nos. 43–46. London. 8vo.—*From the Society.*

List of the Society of Antiquaries of London, 1856. 8vo.—*From the Society.*

Journal of the Geological Society of Dublin. Vol. vii., Part 4, Dublin, 1857. 8vo.—*From the Society.*

Bulletin de la Société Impériale des Naturalistes de Moscou. Annee 1853, Nos. 3, 4; 1855, Nos. 2, 3, et 4; 1856, No. 1. Moscou. 8vo.—*From the Society.*

Extrait du Programme de la Société Hollandaise des Sciences à Harlem, pour l'annee 1857. 4to.—*From the Society.*

Monthly Returns of the Births, Deaths, and Marriages registered in the eight principal Towns of Scotland. March, April, May, June, July, Sept., 1854. 8vo.—*From the Registrar-General.*

Memoirs of the Geological Survey of India. Calcutta, 1856. 8vo. —*From the Governor-General of India.*

Journal of the Royal Geographical Society. Vol. xxvi. London, 1856. 8vo.—*From the Society.*

Flora Batava. 181 aflevering. 4to.—*From the King of Holland.*

Método lexiologica y hermeneutico para aprender la lengua francesa fundado en las leyes de entomologia, analogia, y onomatopeya, que presiden à la formacion de las Lenguas. Par Don Vicente Alcober y Largo. Madrid, 1857. 4to. —*From the Author.*

Quarterly Journal of the Chemical Society. No. 37. 8vo.—*From the Society.*

Nouveaux Mémoire sur la Question relative aux Ægilops triticoides et speltiformis. Paris, 1857. 8vo.

Archives du Museum d'Histoire Naturelle publiées par les Professeurs-Administrateurs de cet Etablissement. Tome ix. Paris, 1856. 4to.—*From the Museum.*

Bulletin de la Société des Sciences Naturelles de Neuchatel. Tome iv., premier cahier. Neuchatel, 1856. 8vo.—*From the Socicty.*

Transactions of the Architectural Institute of Scotland. Vol. v. (Session 1855–6). Edinburgh, 1856. 8vo.—*From the Society.*

Astronomical, and Magnetical, and Meteorological Observations made at the Royal Observatory, Greenwich, in the year 1855, under the direction of George Biddell Airy, M.A., Astronomer-Royal. London, 1857. 4to.—*From the Board of Admiralty.*

Tables de la Lune construites d'après de principe Newtonien de la gravitation universelle, par P. A. Hansen, Directeur de l'Observatoire Ducal de Gotha. Imprime aux frais du Gouvernement Britannique. Londres, 1857. 4to.—*From the Board of Admiralty.*

Ophthalmic Hospital Reports and Journal of the Royal London Ophthalmic Hospital. Edited by J. F. Streatfield. No. 1, October 1857. London, 8vo.—*From the Editor.*

Magneticäl and Meteorological Observations made at the Hon. East India Company's Observatory, Bombay, under the superin-

tendence of Lieutenant E. F. T. Ferguson, I.N. For years 1854-5. Bombay, 1855-6. 4to.—*From the Hon. E. I. Company.*

Catalogue of the Library of the Philosophical Institution of Edinburgh. Edinburgh, 1857. 8vo.—*From the Institution.*

Jahresbericht über die Fortschritte der reinen, pharmaceutischen und technischen Chemie, Physik, Mineralogie und Geologie. Unter Mitwirkung von H. Buff, F. Knapp, H. Will, F. Zamminer, herausgegeben von Justus Liebig und Hermann Kopp. Für 1856. Giessen, 1857. 8vo.—*From the Editors.*

Journal of the Proceedings of the Linnean Society. Vol. ii., Nos. 5 and 6. London, 1857. 8vo.—*From the Society.*

Bulletin de la Société des Sciences Naturelles de Neuchatel. Tome iv., deuxième cahier. Neuchatel, 1857. 8vo.—*From the Society.*

Proceedings of the Royal Geographical Society of London, No. 8. London, 1857. 8vo.—*From the Society.*

Address delivered at the Anniversary Meeting of the Geological Society of London, on 20th February 1857, by Colonel J. E. Portlock, R.E., President of the Society. London, 1857. 8vo. —*From the Author.*

A new Classified Catalogue of the Library of the Royal Institution of Great Britain, with indexes of Authors and subjects, and a list of historical Pamphlets chronologically arranged. By Benjamin Vincent. London, 1857. 8vo.—*From the Institution.*

Die Bohmischen Exulanten in Sachsen. Von Christian Adolph Pescheck. Leipzig, 1857. 8vo.—*From the Author.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. 1855, 1856. Berlin, 4to.

Transactions of the Zoological Society of London. Vol. iv., Part 4. London, 1857. 4to.

Twenty-fourth Annual Report of the Royal Cornwall Polytechnic Society, 1856. Falmouth. 8vo.

Proceedings of the Zoological Society. Nos. 310-338. London. 8vo.

The Bakerian Lecture. Experimental Relations of Gold (and other Metals) to light. By Michael Faraday, D.C.L. London, 1857. 4to.—*From the Author.*

Sur le Climat de la Belgique. De l'Etat du Ciel en général, par A. Quetelet. Bruxelles, 1857. 4to.—*From the Author.*

Annales de l'Observatoire Royal de Bruxelles, publieés, aux frais de l'Etat, par le Directeur, A. Quetelet. Tome xi. Bruxelles, 1857. 4to.—*From the Observatory.*

Observations des Phénomènes Périodiques. Bruxelles. 4to.—*From M. Quetelet.*

Contributions to the Meteorology and Hydrography of the Indian Ocean. By Charles Meldrum, A.M. Part 1. Mauritius, 1856. 4to.—*From the Author.*

Monatsbericht der Königlichen Preuss. Akademie der Wissenschaften zu Berlin. Januar–August 1857.—*From the Berlin Academy.*

Denkschriften der Kaiserlichen Akademie der Wissenschaften. Mathematisch - Naturwissenschaftliche Classe, Zwolfter Band. Vienna, 1856. 4to.—*From the Academy.*

The Quarterly Journal of the Geological Society. Vol. xiii. Parts 2 and 4. London, 1857. 8vo.—*From the Society.*

Ueber die Placodermen des Devonischen Systems. Von Dr Christian Heinrich Pander. St Petersburg, 1857. 4to.—*From the Corps des Ingénieurs des Mines de Russie.*

Monographie der Fossilen Fische des Silurischen Systems der Russisch-Baltischen Gouvernements. Von Dr Christian Heinrich Pander. St Petersburg, 1856. 4to.—*From the Corps des Ingénieurs des Mines de Russie.*

Bulletin de la Société Impériale des Naturalistes de Moscou. Tome xxvii., No. 1. Moscou, 1854. 8vo.—*From the Society.*

The Canadian Journal of Industry, Science, and Art, conducted by the Canadian Institute. New Series, Nos. 8 and 10, July–September 1857. Toronto. 8vo.—*From the Society.*

Bulletins de l'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique. Tome xxii. 2ieme partie; Tome xxiii. Bruxelles, 1855-6. 8vo.—*From the Academy.*

Journal of the Statistical Society of London. Vol. xxii., Part 2. (June 1857). London. 8vo.—*From the Society.*

Compte Rendu de l'Académie Impériale des Sciences de St Petersbourg. 1852, 1853, 1854, 1855. St Petersbourg. 8vo.—*From the Academy.*

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch - Naturwissenschaftliche Classe, Band xxii.; Band xxiii., Heft 1. Philosophisch-Historische Classe, Band xxi., Heft 3; Band xxii., Heft 1 und 2. Vienna, 1856-7. 8vo.—*From the Imperial Academy, Vienna.*

Annuaire de l'Observatoire Royal de Bruxelles, par A. Quetelet, 1856, 1857. Bruxelles. 12mo.—*From the Author.*

Berichte über die Verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften zu Leipzig. Mathematisch-Physische Classe, 1856, No. 2; 1857, No. 1. Leipzig. 8vo.—*From the Royal Saxon Society.*

Abhandlungen der K. S. Gesellschaft der Wissenschaften zu Leipzig. Mathematisch-Physische Classe, 1857. Leipzig. 8vo.—*From the same Society.*

Proceedings of the Literary and Philosophical Society of Liverpool, Session 1856-7. Liverpool, 1857. 8vo.—*From the Society.*

Memorias de la Real Academia de Ciencias de Madrid, Tomo iv. Madrid, 1857. 4to.—*From the Academy.*

Judicial Statistics, Part 1, England and Wales. Police Criminal Proceedings.—Prisons. Returns for the year 1856.—*From the Secretary of State.*

Proceedings of the Royal Society of London. Vol. viii., Nos. 26 and 27. London, 1857. 8vo.—*From the Society.*

Memoire della Reale Accademia delle Scienze di Napoli. Vol. i., Fasc. 1, 2. 4to.—*From the Academy.*

Rendiconto della Societa Reale Borbonica. Napoli, 1856. 4to.—*From the Society.*

Quarterly Journal of the Chemical Society. July 1857. London. 8vo.—*From the Society.*

Journal of the Statistical Society of London. Vol. xx., Part 3. London, 1857. 8vo.—*From the Society.*

List of Fellows of the Statistical Society of London. 8vo.—*From the Society.*

Oversigt over det Kongelige Danske Videnskabernes Selskabs Forhandlinger og dets Medlemmers Arbeider i Aaret 1856. Kjobenhavn, 1856. 8vo.—*From the Society.*

Biographical notice of the late Thomas Thomson, M.D. 1857. 8vo.—*From the Author.*

Address at the Anniversary Meeting of the Royal Geographical

Society, 25th May 1857. By Sir Roderick I. Murchison, President. London, 1857. 8vo.—*From the Society.*

M. le Baron Cauchy: Lettre de M. Biot a M. de Falloux. Paris, 1857. 8vo.—*From E. Cauchy.*

Silliman's American Journal of Science and Arts. July 1857. 8vo.—*From the Editors.*

Monthly Notices of the Royal Astronomical Society. Vol. xvi. London, 1856. 8vo.—*From the Society.*

Memoirs of the Royal Astronomical Society. Vol. xxv. London, 1857. 4to.—*From the Society.*

Philosophical Transactions of the Royal Society of London, for the year 1856. Vol. cxlvi., Part 3; do. for 1857, Vol. cxlvii., Part 1. London. 4to.—*From the Society.*

Memoire della Reale Accademia della Scienze de Torino. Serie Seconda, Tomo xvi. Torino, 1857. 4to.—*From the Academy.*

Kongliga Svenska Vetenskaps-Akademiens Handlingar ny foljd. Första Bandet, törsta häftet. Stockholm, 1855. 4to.—*From the Royal Academy of Sciences, Stockholm.*

Exposition des Operations faites en Lappoine pour la determination d'un arc du méridien. Stockholm, 1805. 8vo.—*From the same Academy.*

Ofversigt af Kongl. Vetenskaps-Akademiens Forhandlingar, för är 1856. 8vo.—*From the same Academy.*

Kongl. Vetenskaps-Akademiens Handlingar, för är 1854. 8vo.—*From the same Academy.*

Berättelse om Framstegen i Insekternas, Myriapodernas och Arachnidernas Natural Historia för 1853 och 1854, till Kongl. Vetenskaps-Akademien afgifven af C. H. Boheman. Stockholm, 1857. 8vo.—*From the same Academy.*

Arsberättelse om Botaniska Arbeten och Upptäckter under ären 1852, 1853, och 1854, (2 Bandet.) Till Vetenskaps-Akademien afgifven af J. Em. Wilkström och N. J. Andersson. 8vo.—*From the same Academy.*

Om förflutna tiders svenska Ordboksföretag, Tal i K. Vetens. Akademiens vid Præsidii nedläggande den 9 April 1856 af Bernh. v. Beskow. Stockholm, 1857. 8vo.—*From the same Academy.*

Bulletin de la Société de Geographie. Quatrieme serie, Tome xiii. Paris, 1857. 8vo.—*From the Society.*

Brief Extract from Memoranda of the Earl of Dundonald, on the use, properties, and products of the Bitumen and Petroleum of Trinidad. London, 1857. Folio.—*From Lord Dundonald.*

The U. S. Naval Astronomical Expedition to the Southern Hemisphere during the years 1849–50, 1851–52. Vol. vi., Magnetical and Meteorological Observations, under the direction of Lieut. J. M. Gilliss, LL.D., Superintendent. Washington, 1856. 4to.—*From Dr Gilliss.*

The following List of Donations, announced at the Society's Meeting on 2d March 1857, was omitted in its proper place in the Proceedings:—

Philosophical Transactions of the Royal Society of London. Vol. cxliv., Part 2, cxlv., and cxlvi. London, 1854–56. 4to.—*From the Society.*

Proceedings of the Royal Society, Vol. viii., No. 24.—*From the Society.*

Annales de l'Observatoire Physique Central de Russie. No. 2. Correspondance Météorologique pour l'anne 1854. St Petersbourg, 1855. 4to.—*From the Observatory.*

Journal of Agriculture, and Transactions of the Highland and Agricultural Society of Scotland. March 1857. Edinburgh. 8vo.—*From the Society.*

The American Journal of Science and Arts. January 1857. 8vo.—*From the Editors.*

Bulletin de la Société de Geographie, Quatrieme serie, Tome xii. 1857. 8vo.—*From the Society.*

Transactions of the Royal Scottish Society of Arts. Vol. iv., Part 4.—*From the Society.*

Natuurkundige Verhandelingen van de Hollandsche Maatschappij der Wetenschappen te Haarlem. Deel xii., tweede verzameling.—*From the Society.*

On certain Trains of Erratic Rocks on the Western borders of Massachusetts, U.S. By Sir Charles Lyell, F.R.S. 8vo.—*From the Author.*

Monday, 21st December 1857.

Professor Kelland, V.P., read from the Chair the following short Biographical Notices of MM. Thénard and Cauchy, two recently deceased Foreign Members of the Society.

In Dr Christison's excellent address at the last meeting, he presented you with biographical sketches of the recently deceased Home Members of this Society. I have been requested to complete his work, by adding a brief sketch of the lives of the two Foreign Members whom we have lost during the past session.

1. *M. Thénard.*—For the information which I have acquired relative to this excellent chemist, I am indebted to Dr Christison, who has furnished me with his personal recollections, and with a biographical souvenir of the deceased by one of his former assistants, M. Le Canu.

The association of the name of Thénard with the progress of Chemistry dates back to the period of history. His first contribution to the science was made so early as the year 1799; the subject being "The Oxygenated Compounds of Antimony, and their Combinations with Sulphuretted Hydrogen." His last was presented in 1856, fifty-seven years later, and is entitled "Memoir on the Bodies whose Decomposition is effected under the influence of the Catalytic Force." To detail all the discoveries of an author whose writings are scattered over so vast a period would be a work of some labour, and might justly be regarded by many of my hearers as a dry and unnecessary detail. A few of the more important only can be noticed.

We owe to him the production of muriatic ether. It is true, however, that Boullay in France, and Gehlen in Germany, made the discovery about the same time with himself. We owe to him also the discovery of oxygenated water, or the binoxide of hydrogen, and consequently that of the peroxide of calcium, of copper, &c., which it produces by reacting on the inferior oxides of these metals. M. Le Canu admits, in reference to this discovery, that a happy accident exhibited to M. Thénard the dissolution of binoxide of barium in water acidulated with nitric acid, without the disengagement of

oxygen; but he argues very justly that the merit consisted in the far-seeing power which could divine the existence of a definite combination of oxygen and hydrogen, essentially distinct from ordinary water.

M. Thénard had the good fortune to labour in conjunction with a host of great men—with Fourcroy, with Dulong, with Biot, with Dupuytren, but, above all, with Gay-Lussac. It is in this last connection, I imagine, that his name comes most frequently under the eye of non-chemical readers amongst us. Gay-Lussac and Thénard published, in conjunction, a series of most valuable memoirs, which were afterwards united in two volumes. Of these volumes Berthollet thus speaks: "They seem to constitute a new science, raised on the old sciences of physics and chemistry as their groundwork." Amongst the vast mass of discoveries which these researches make known, I have space to mention only two: 1. A highly important series of facts tending to throw light on the relation between the chemical and the electrical energy of the voltaic pile. For example, that acidulated water, as compared with pure water, increases the chemical action of the pile, but diminishes the electrical; and that those fluids which were found most efficient in exciting the chemical powers of the battery are the most rapidly decomposed when subjected themselves to its action. 2. The indication of the means of obtaining considerable quantities of potassium and sodium, by subjecting caustic potash and soda to the contact of iron at a high temperature; and the train of consequences which flowed from the facility of producing those metals. The Memoir which contains the process referred to appeared in the *Moniteur* of the 15th and 16th November 1808. In it was announced the existence of a particular radical, boron, which Davy described a month later in a valuable paper read to the Royal Society of London.

Not the least important, however, of M. Thénard's publications was his *Traité de Chimie*, which has gone through six editions. He had a happy talent for popularizing, without the sacrifice of strict scientific accuracy. His genius lay in arranging the parts, in developing truths in succession, in bringing out the characteristic facts, and causing the whole science to rest symmetrically on them. And the same power of popularizing and arranging was observable in his lectures. The courses which he delivered at the Athenæum, at the

Faculty of Medicine, at the *Ecole Polytechnique*, at the College of France, were admirable of their kind. Notwithstanding his intimate acquaintance with the subject, and his long experience as a lecturer, he never presented himself before an audience, without having carefully planned the lecture, and determined the exact order and position which every part should occupy. He used to say that each fact had its own proper place, where alone it could be exhibited in relief, and that it was the duty of the Professor to determine this place beforehand, just as much as it is the duty of an author to clear his sentences of feeble tautology, and to attach the right word to every idea. In consequence of this care, his lecture was always complete, always a continuous lesson on the subject in hand; free alike from deficiency and from exuberance.

It is indeed in his character as a lecturer, that M. Thénard is best studied. On the public platform, the peculiar idiosyncracies of the whole man came out spontaneously. Let me endeavour to present him to you, as he stands before his class. Imagine a vast amphitheatre capable of holding a thousand persons—every seat occupied—the very lobbies and passages crowded to overflowing. At the back of the contracted space allotted to the Professor and his apparatus, stands a huge black board, well covered with chemical formulæ. The assistant whose duty it has been to prepare the experiments, stands anxiously regarding his work. The lecturer enters. Your ideas, derived from Hogarth, have perhaps pictured to you a thin spare man with a hatchet face, and you start when your eyes rest on a figure placed in strong relief against the black board, whose firm build and massive countenance more than come up to the typical John Bull of your own land. His broad full eye, set off by a dark mass of hair, first glances at the apparatus, then rises and haughtily scans the audience, as if to measure their capacity, and finally drops on the assistant, who quails beneath its weight. The lecture begins. So clear, so forcible, so continuous, is the stream which flows from the speaker's lips—so appropriate, so neat and so well performed are the experiments, that the hour passes over quickly and insensibly. But should any accident happen; should the unfortunate assistant have mistaken his directions; woe betide him. The presence of a thousand persons places no restraint on the lecturer's indignation. On one occasion, when he had given way to an un-

usually violent outburst, an illustrious hearer, said to be Baron Humboldt, thought it his duty to interfere, and request the master to have a little more patience with his assistant. The request was granted, and all went smoothly during the remainder of the lecture. For two days sunshine continued. On the third day M. Thénard, on entering the room, perceived a portion of the apparatus in a condition which foretold the failure of the experiment. Placing himself right in front of the benevolent stranger, and looking him full in the face, with his finger pointing to the unhappy apparatus, he cried out in the theatrical voice which he inherited from the tragedian Talma, "Friend, I promised to restrain my anger, and I have faithfully kept my word; give me back my promise, or you will see me expire before your eyes." The stranger had no alternative but to bow assent. You may imagine what followed—I will not attempt to describe the scene.

Report says that the assistant was sometimes a match for the professor. On one occasion M. Thénard ironically commiserated him in these words, "Poor fellow, you will never do any good." To which the other replied, "Sir, you compliment me; it is the very same thing Fourcroy predicted of yourself when you were his assistant."

Beneath that rough exterior, and that fiery temper, there lay an honest conscience and a warm heart. Again and again did his assistants tender their resignation, but it was never accepted; and public exhibitions of anger were followed by private acts of kindness. When in 1832, M. Thénard lay ill of a fever, his two assistants, M. Le Canu and M. Clément Desormes, undertook the duty of sitting up alternately by his bedside. One night the latter was so ill of a cough that the patient forgot his fever, in his anxiety to watch over his nurse.

M. Thénard died full of years, and rich in honours and titles.

2. *Baron Cauchy.*—At the suggestion of Professor Forbes, I had drawn up a brief notice of the life of our mutual friend M. Cauchy, when the biographical letter of M. Biot fell into my hands. This letter has enabled me to add certain details which I had previously been unable to supply, and to which the present sketch owes its chief interest. As however M. Biot's statements, in one or two

instances, differ from my own, which are based, for the most part, on M. Cauchy's writings, I have allowed the latter to remain as I originally penned them.

In Baron Cauchy, the world has lost the last of those eminent cultivators of mathematical science who sprung up in the early part of the present century, formed in the school of Laplace and Lagrange. The names of Poisson, Gauss, Fourier, Abel, Jacobi, and Cauchy, form a constellation of abstract mathematicians, such as the world never before saw existing together, and will probably never see again. Agustin-Louis Cauchy was born on the 21st of August 1789, the period of universal confusion throughout France. His father, who was keeper of the archives of the senate, appears to have been exempt from the turmoils which embroiled every grade of society at that time. Perceiving the mathematical bent of his son's mind, he took pains to bring him frequently under the notice of Lagrange. This illustrious philosopher interested himself in the education of the lad, and gave the father a piece of advice which no doubt greatly surprised him, and which, coming from such a source, it is worth our while carefully to note. These were his words:—"Do not allow your son to open a mathematical book, nor to touch a single diagram, until he has finished his classical studies." Sound and excellent advice under the circumstances. Preliminary education has for its object the cultivation of all the faculties, not the developement of any one to the exclusion of the others. It fulfils its functions as well when it tends to check and keep down an overwhelming bias in one direction, as when it aims at drawing out the dormant powers in another. The wisdom of the advice of Lagrange may be inferred from the whole life of Cauchy. In his classical studies he was eminently successful, and received the highest award of his class. The taste which he now acquired for languages never forsook him. In his later years he read deeply in patristic theology, and delighted in pouring forth his divinity for the instruction of the young. Nor did his exclusive devotion to classical study stand in the way of his professional advancement. After a single course of mathematics under a public professor, Duret, he presented himself, at the age of sixteen, for the entrance examination of the *Ecole Polytechnique*, and was ranked second on the list.

It is not necessary to trace, step by step, his advance in his pro-

fession. Suffice it to say, that he became *ingénieur en chef* in 1823, and was employed on many public works.

Prior to this date, however, he had been brought prominently before the world. The French Institute had proposed as the subject of the Prize Essay for 1816, the determination of the wave motion of a disturbed fluid. M. Poisson, who, as he himself states, had been for a long time engaged on this problem, sent in a first memoir on the subject in October 1815, followed by a second in December, There is reason to suppose, that one object which the Institute had in view in proposing this problem was to draw out M. Poisson. That any living man should have succeeded in wresting the prize from him, who was justly regarded as a giant in investigations of the kind, is matter of astonishment to this day. That that man should have been Cauchy, who justly looked up to Poisson as his model for imitation, and who, years after, acknowledges with gratitude his obligations to that great mathematician, as the guide of his early career, must have greatly surprised even Poisson himself; yet such was the fact. The prize was awarded to Cauchy on the ground of the greater generality and freedom from limitations which his solution of the problem presented. I am not sure that M. Poisson was satisfied with the decision. At any rate, his own memoir was immediately published, whilst that of M. Cauchy, who was not then a member of the Institute, lay twelve years in manuscript. In this case the Institute, by following their ordinary vicious practice, conferred a real benefit on science, by allowing M. Cauchy to add copious notes to his essay. The two works of Poisson and Cauchy now stand together as masterpieces of analytical investigation, and form the starting-points from which all future writers on the subject must commence their progress. Prior to this period, M. Cauchy had published several admirable papers on subjects connected with pure geometry; and the proof now afforded of the fertility of his genius would at once have secured him an admission into the Institute, had there been a vacancy. The termination of the brief struggle of the hundred days unhappily too soon created the desired vacancy, in a manner little to the benefit of M. Cauchy, who was named to fill it. The Institute had been remodelled by Napoleon in 1803, and the legitimate monarchy, on their second restoration, at once resolved to re-establish it in its original form. In effecting this

re-establishment it is not much to be wondered at that the Government should see fit to strike out the names of two members, Carnot and Monge—names not more distinguished by the brilliant talent of their possessors, than by their connection with that of the first consul Napoleon. Great as was Cauchy's genius, aimable as was his disposition, it could not prevent his sharing in the general feeling of disgust and dissatisfaction at the expulsion of Monge. Connected as the latter had been with the revolution, he had raised his hand when in power only as a shield to protect his colleagues from the proscription of the Reign of Terror. To sit in his place was to participate in the obloquy attached to his removal. Looking at the matter from this distance of time, however, we cannot impute the slightest blame to Cauchy. He was a legitimist by conviction. In the depth of his ardent piety he believed that the interests of religion were bound up with those of the monarchy; and as he never for a moment doubted the propriety of the act which placed his name on the roll, so he accepted the appointment without hesitation, firmly and conscientiously believing that it was his duty so to act.

About the same time he was appointed a professor adjunct in the *Ecole Polytechnique.* He occupied besides two other chairs. The lectures which he delivered are well known to the world under the titles of "*Cours d'Analyse Algebrique,*" "*Leçons sur les Calculs, &c.,*" "*Resumé des Leçons sur le Calcul Infinitesimal,*" "*L'application de l'Analyse à la Théorie des Courbes.*" He published also at this period various important memoirs, especially one on integrals taken between imaginary limits.

In 1826, he undertook the Herculean task of conducting and carrying on a scientific periodical, under the title of *Exercises de Mathématiques,* confined exclusively to his own writings. After the lapse of little more than four years the work had advanced into the fifth quarto volume, without any abatement of originality or of interest, when it received a sudden interruption. M. Cauchy, as we have said, was a warm adherent of the legitimate monarchy, and its overthrow was his own. Following the example of its predecessors, the new government demanded an oath of allegiance from all men holding public situations. This oath appears to have made no stringent demands, none which a scientific man might not safely have conceded, whatever his political principles. But M. Cauchy's conscience

was tender even to excess; and although he had now a wife and two children depending on him, he resigned all his employments and retired into voluntary exile in Switzerland, sacrificing his prospects "to devotion to the unfortunate, and the sincere love of truth." The King of Sardinia, informed of the circumstance, created for him a Chair of Mathematics in Turin. This appointment he accepted, and lectured in the Italian language with great success. There he recommenced the publication of his *Exercises*, under the appellation of *Resumés Analytiques*. Having remained in Turin about two years, the voice of his sovereign (Charles X.) called him to Prague, to take part in the education of the Count De Chambord. At Prague he was rejoined by his wife and family; and for the succeeding six years he attached himself to the persons of the royal exiles. Again he resumed his *Exercises*; and having, I believe, plenty of spare time on his hands, he appears to have amused himself with lithography. In this new form he issued his publications; and it is to be feared that a complete set does not exist. I have the impression that M. Cauchy informed me, with his own lips, that he did not himself possess copies of all his lithographed memoirs. At any rate, they are almost unknown even in France.

Charles X. died on the 6th of November 1837; and M. Cauchy's functions as tutor to the Count of Chambord having ceased, he returned to Paris in 1838, and resumed his place at the Institute. He now took the title of Baron Cauchy, but whether by succession or by creation I do not know. Having no public occupation, he divided his time between the pursuits of science and the performance of deeds of benevolence. In both his voluntary labours he was indefatigable. The time he bestowed on each seemed to preclude the possibility of his having a moment for attention to the other. During the last peaceful nineteen years of his life he published in the different volumes of the Institute, and in the *Comptes Rendus*, upwards of FIVE HUNDRED memoirs, besides a multitude of reports and criticisms. This immense mass of work abounds in new thoughts, new methods, and sweeping generalizations, and may be regarded as a vast storehouse from which the next generation of mathematicians will draw their resources. It is to be regretted that M. Cauchy did not concentrate his attention more. Many of his papers are in a very rude state, containing only the germ of an idea, which

he failed fully to develope. In fact, during his later years he reminds one a little of Hooke, who was wont to rise at the conclusion of every memoir which he heard, and declare that he had something in store on the same subject. The notation, too, of some of his papers is a notation peculiar to himself; and the methods employed are often those of a new calculus, the *Calcul des Residus*, invented by him, but not generally adopted by mathematicians. All these circumstances will conspire to lock up M. Cauchy's papers for a considerable period. But no one hesitates about their value. In those subjects where the results of his analysis can be easily tested, such as in the determination of the motion of elastic media, with its application to the undulatory theory of light; or in the doctrine of planetary disturbances as applied to the movements of the small planet Pallas, M. Cauchy was, and will continue to be, the received authority.

No sooner had he settled at Sceaux, in the neighbourhood of Paris, than, for the fourth time, he commenced the publication of his *Exercises*, which he continued to the day of his death. The extraordinary amount of work thus performed by one man strikes the mind with astonishment. It is true that many of his papers are but the exhibition in type of the pages of his scribbling book. He had the habit during life of preserving all his loose thoughts and unsuccessful attempts, by working constantly on paper bound in volumes. Thus whatever he penned was sure to be preserved. We may perhaps be permitted to regret this circumstance, as its evident tendency was to present a bar to the operation of that polishing process which most writers find so essential to the success of their works. But M. Cauchy was not allowed to remain nineteen years in the silence of his study. On the 13th of November 1839, the *Bureau des Longitudes* called him to the place previously occupied by M. Prony. This was an unfortunate event. It was evident to all those who knew M. Cauchy that he would never consent to take the requisite oaths. Negotiations were accordingly at once set on foot by those who desired his presence amongst them, with the object of inducing the Government to dispense with the formality. Men of science of every shade of political opinion interested themselves in the matter; but without success. The Government did, indeed, consent to reduce the oath to the merest matter of form, but an

absolute dispensation it would not concede; and Cauchy was less likely to move towards the opposite party than they towards him. With an obstinacy quite puerile, to use M. Biot's phrase, he doubled on their path at every turn they took to encompass him. His resolve rendered all their efforts hopeless; and finally his appointment was cancelled. Those only who know what Cauchy was capable of, will be able to estimate the loss astronomy has sustained from this untoward event.

In 1848 France saw another revolution, and a new republican government. Oaths were now dispensed with, and M. Cauchy resumed his Chair of Mathematics in the Faculty of Sciences. But the events of the 2d December 1851 once more unseated him. Again, the scientific men of France (to their infinite credit be it recorded) used every effort to induce the newly constituted authorities to make his an exceptional case, and dispense with every formality. At first without success; but after a while, when the Emperor had become securely established in his government, he had the good sense to cause M. Cauchy to be restored to his chair, fettered by no conditions. Whether from conscientious scruples or otherwise, it is certain M. Cauchy never appropriated to his own use one farthing of his salary. The whole was devoted to deeds of charity. As the dispenser of blessings to the poor, he knew neither monarchists nor republicans. In the neighbourhood of Sceaux, where he resided, he was the prime mover in every labour of love. On one occasion the mayor remonstrated with him on the prodigality of his beneficence. His reply was, "Be not concerned; I am only the channel; it is the Emperor that pays the money," alluding to his salary as professor.

The scientific character of M. Cauchy requires no exposition. I am content to adopt the judgment of a competent authority, the Dean of Ely, pronounced nearly a quarter of a century ago, which will be fully confirmed by future eulogists. "M. Cauchy," he says, "is justly celebrated for his almost unequalled command over the language of analysis."

With the private life of a scientific man the biographer has properly little to do. But in the present instance, the brilliant virtues of the Christian shine so brightly upon his genius, that the latter, dazzling as it is, fails to eclipse the former. M. Cauchy's labours

among the infirm, the destitute, and the young, are the labours of a true apostle. His march was always forward; his watchword always duty. As seen by the eye of the man of science, he was absorbed in study; as seen by the eye of the man of God, he was absorbed in labours of love. In every scheme for the instruction, for the sustentation, for the elevation of his commune, he was ever active, ever devoted. No amount of labour, no sacrifice of time or of money, was too great for him. He was accustomed to wait on the mayor almost daily, and often several times in the day; and he brought with him all his resources of heart, of head, and of purse. Now to recommend a poor infirm man to the charity which primarily came from himself; now to suggest the adoption of an orphan whom he had hunted out; now to restore a wounded soldier to his family; now to organize a school; now to forward the working of an hospital. "He had (says the eloquent mayor of Sceaux) two distinct lives—the Christian and the scientific life—each so full, so complete, that it would have served to confer lustre on any name." A characteristic feature in his good works was that truly Christian one, that he conducted them without ostentation, and without assuming even the shadow of merit.

A little before his death, and when it was but too evident that his end was approaching, he was busily engaged with the curé of the parish in arrangements for the benefit of the people. Perceiving that he was overtaxing his strength, the curé besought him to take rest, adding, that in so doing, he would second the efforts of those who were praying for his restoration to health. His reply was in these words, and they are the last of his recorded words:—"Dear Sir, men pass away; but their works remain. Pray for the work."

I have a pleasing remembrance of the retired chateau at Sceaux, with its vine-trellised gardens; and of the beaming countenances of M. Cauchy and his agreeable family. In that retreat all was as bright as the summer sky. To the great and good man, whose loss we now lament, it was the dawning brightness of the morn "that shineth more and more unto the perfect day."

The following Communications were then read :—

1. Excursions in the Troad, with Observations on its Topography and Antiquities. By Dr William Robertson, F.R.C.P.E. Communicated by Dr J. Y. Simpson.

The author had resided for fifteen months, in 1855–56, within a few miles of the Plain of Troy, and had made excursions over it at all seasons.

His paper commenced with a description of the western extremity of the Asiatic coast of the Hellespont, between Abydos and Koum Kaleh, including the River Rhodius and the sites of Dardanus, Ophrynium, Pteleos, Rhætium, and Novum Ilium, all of which he considered positively identified. A minute topographical account followed: first, of the valley of the Dumbrek (Simois); next, of the valley of the Mendere (Scamander); next, of the valley of the Kimair (Thymbrius of Strabo); and lastly, of the hilly country between these streams, and of the relics of antiquity which it included.

The author believed that Homer's Troy must have stood, like the Novum Ilium of Strabo, on the hill now called Hissarlik—that the mouth of the Scamander was formerly two miles to the east of its present main channel, and that the In-Tepeh-Osmak and Kalifatli-Osmak might be regarded as its terminations in the times of Homer and Strabo. He showed that these, and the other Osmaks in the valley of the Mendere, were at present merely winter channels of the river, and that in summer they would be dry nullahs, but for the drainings from the extensive marshes left by the winter inundations of the plain. He believed that the bay between Koum Kaleh and In-Tepeh was deeper in the days of Homer, and that its eastern extremity, in particular, had during the last 2000 years been materially encroached upon by deposits of mud and sand from the rivers and sea.

He remarked that Homer made no mention of a *river* Thymbrius, and that the Thymbra which is alluded to in the Iliad very probably stood in the valley of the Simois, to which it has ultimately transferred its name. The Thymbra and Thymbrius of Strabo were certainly situated near the modern farm of Ak-tchai-kioi on the Kimair.

An account was given of various excavations, made in 1856, in some very ancient places of sepulture at Ak-tchai-kioi, and among the ruins of Dardanus. In the former of these cemeteries the bodies had been buried, entire and unburnt, in very large earthen urns, along with pateræ and lachrymatories of materials and forms indicating the earliest stage of Grecian art. The cemetery at Dardanus was more modern; and the bodies, which had usually been burnt, were here found in rectangular cysts, built of flat stones or tiles, and carefully cemented. The pottery found at Dardanus was often of very elegant workmanship, and the painted or glazed figures upon it less rude than those observed at Ak-tchai-kioi; but it was singular that no medals, nor coins, nor even traces of inscription, had been found among these tombs.

2. On the Composition of the Building Sandstones of Craigleith, Binnie, Gifnock, and Partick Bridge. By Thomas Bloxam, Assistant Chemist, Laboratory of Industrial Museum. With a Preliminary Note by Professor George Wilson, Director of the Industrial Museum.

Preliminary Note.

In prosecution of the analyses of Scottish building stones commenced last winter in the laboratory of the Industrial Museum, by the examination of the bed-rock from Craigleith quarry, four more sandstones have been analyzed since May 1856 by Mr Bloxam. The stones in question are the Craigleith liver-rock, and the Binnie sandstone, from the neighbourhood of Edinburgh, and the Gifnock and Partick Bridge stones, from the neighbourhood of Glasgow.

As in the case of the coarser Craigleith rock, the chief points inquired into, in the case of each stone, have been the following:—

1. The specific gravity.
2. The amount of water naturally present.
3. The amount of water absorbed by entire aqueous immersion under air.
4. The amount of water absorbed by partial aqueous immersion, distinguished in the sequel as absorption by "capillary attraction."
5. The amount of water absorbed by entire aqueous immersion under the air-pump vacuum.
6. The amount of substance soluble in pure water.
7. The amount of substance soluble in water saturated with carbonic acid.

8. The amount of substance soluble in dilute hydrochloric acid.
9. The amount of clay present.
10. The quantitative composition.

From the entire investigation it will be seen that, as in the case of the Craigleith bed-rock, water alone dissolves something from each stone; water charged with carbonic acid dissolves an additional amount of substance; and water containing mineral acids, effects still farther solution. The conviction I had long entertained, that the iron stains in sandstones are occasioned not only by the oxidation of iron pyrites, but by the solution of iron in water containing carbonic acid, and which led to the trial, in the case of the Craigleith bed-rock, of the action of carbonic acid water upon its powder, is now extended and confirmed.

The results in full are stated in the succeeding statements by Mr Bloxam, who has had the entire charge of the analytical inquiry. His interesting observation, that cobalt occurs in Craigleith stone, previously announced in relation to its coarser variety, is now extended to the denser liver-rock and to the Gifnock sandstone.

Copper also has been shown to be present in the Binnie sandstone, a metal not hitherto suspected to exist in rocks of its class. Mr Bloxam has also pointed out the occurrence of nodules of protocarbonate of iron in the Partick stone, a peculiarity which probably will not be found confined to that rock; since, in truth, it is but the most exaggerated form of that occurrence of carbonate of iron in sandstones, to which the extraction of iron from them by carbonic acid water pointed. Nevertheless, I was quite unprepared for the carbonate of iron occurring in separate masses of considerable magnitude, nor was it in consequence of any hypothesis, but solely by careful analysis, that Mr Bloxam made this curious discovery. The explicit table which he has constructed, and the commentary which precedes it, render any further remarks on my part unnecessary.

G. W.

1. *Craigleith Liver Sandstone.*

The experiments upon the Craigleith liver sandstone were made with carefully-selected specimens of the stone. The results are stated in full in the table.

2. *Binnie Sandstone.*

The second stone subjected to analysis was procured from Binnie

quarry; it was chosen not only as a building material in great repute, but also with the view of investigating the bituminous matter which is both disseminated through it, and found in sufficiently large quantities to admit of a special inquiry.

In the specimen alluded to, the bitumen appeared in small spots, becoming more visible when the stone was heated to 212° Fahr. When held in a flame, it melted, burned, and left the stone quite white.

To the consideration of this curious substance the last part of this paper is entirely devoted; and the experiments upon the stone itself are given in the table.

I now proceed to a few remarks upon the bituminous substance already briefly noticed as occurring in the Binnie stone.

It is a brittle substance, resembling wax to the touch, fusing at 240° Fahr., and boiling above 680° Fahr.

It is slightly soluble in alcohol, imparting to it an acid reaction; it is somewhat more soluble in ether, in which case the solution also has an acid reaction. It is also soluble to a slight extent in bisulphide of carbon; turpentine, however, is its best solvent, giving a solution of a brown colour.

The specific gravity of the bitumen is ·955; when heated it completely melts, then boils, and finally burns away, leaving a trace of ash.

A large quantity of it was burned and the ash examined, when the following substances were found:—silica, iron, soda, and magnesia.

When subjected to destructive distillation, it furnishes two different products: the first solidifies as soon as it distils over; the second remains liquid even at 32° Fahr.; and exhibits the properties of paraffine oil.

The first product, when treated with ether, yielded paraffine in large quantity.

A quantitative estimation of the ash and volatile matter gave the following results:—

Volatile, ...	99·86
Ash, ...	·06
	99·92

Water ·68 per cent.

A portion of the bitumen was subjected to organic analysis with chromate of lead, and gave a mean result as follows :—

Carbon,	84·37
Hydrogen,	14·89
Water at 212° Fahr.,	00·68
Inorganic constituents,	·06
	100·00

3. *Gifnock Sandstone.*

The third variety submitted to investigation was from Gifnock quarry, situated between two or three miles north of Glasgow ; it was procured from Mr Napier, chemist, Partick, Glasgow.

The stone appeared much disintegrated and easily broken.

The results of the experiments upon this stone, and also upon the Partick sandstone, may be seen by referring to the table.

4. *Partick Bridge Sandstone.*

The fourth stone made the subject of experiment was Partick Bridge quarry, about a mile and a half due west from Glasgow.

In the preliminary process of pulverization, preparatory to analysis, some pieces of a black-coloured substance, associated with iron pyrites, were found disseminated through the stone, which were carefully separated, and made the subject of special inquiry.

When heated, this substance blackened, due to the presence of a small quantity of organic matter ; its solubility in different menstrua was ascertained, dilute hydrochloric acid being first added ; it had, however, little or no action.

The probability of this substance being clay was suggested to me by others ; but from its extreme hardness and general weight the supposition did not seem likely. I was led, therefore, to try it by fusion with alkaline carbonates. The fused mass was treated, as usual, with dilute hydrochloric acid, when a black residue was left, which entirely dissolved in more concentrated acid.

A small portion of this powder was collected and examined ; it was attracted by the magnet, and its solution in hydrochloric acid yielded nothing but iron in the state of protoxide. This circumstance suggested the probability of the supposed clay being, firstly, clay very rich in protoxide of iron, or, secondly, entirely an iron compound, devoid, or nearly so, of clay ; for, on examining the acid solution of the fused mass, nothing but a trace of alumina was discovered, at once proving the absence of all clay.

The black powder attracted by the magnet yielded by analysis 5·78 peroxide of iron, from 6·01 of substance; while, had the substance been magnetic oxide of iron, the amount of peroxide yielded would have been 6·63; so that we may safely conclude that the substance was nothing more than magnetic oxide of iron, produced during the fusion with the alkaline carbonate.

The next experiment that suggested itself was to try the action of more concentrated acid upon the supposed clay. The whole of the substance immediately dissolved in moderately strong hydrochloric acid, with the evolution of much carbonic acid gas; the solution on analysis yielded a large quantity of protoxide of iron, together with carbonate of lime, and traces of sulphate of lime, also alumina, magnesia, and soda.

As a conclusive experiment, the action of carbonic acid gas upon the substance suspended in water was tried. Upon filtering the liquid at the close of the experiment, and subsequently analyzing it, much protoxide of iron was dissolved.

It is obvious, from the foregoing remarks, that the pieces of substance found disseminated through the stone consist entirely of protocarbonate of iron.

The ill effects of these nodules of proto-carbonate of iron are at once evident; for a block of stone freshly cut from the quarry exhibits no external mark of their presence within it to guide us, and it is not until the rain and air have had their full effect upon it for some time that the stain renders itself visible as a dark reddish-brown ring of peroxide of iron.

Analysis of Building Sandstones.

Name of Stone.	Specific Gravity.	Water naturally contained, or Loss on Drying, at 212° F.	Water absorbed by continued immersion.	Water absorbed by Capillary Attraction.	Water absorbed under the Air-Pump.	Action of Water on the Stone.	Action of Carbonic Acid Water upon the Stone.	Action of dilute Hydrochloric Acid on the Stone.
Craigleith Liver-Rock.	2·432.	3·2 fluid ounces per cubic foot.	5· imperial pints per cubic foot.	5·11 imperial pints per cubic foot.	7·7 imperial pints per cubic foot.	6 ounces boiled on 400 grains for 1 hour 40 minutes, dissolved from it ·38 of a grain.	Dissolved Protoxide of Iron, Lime, and Soda.	Dissolved Silica, Alumina, Iron, Cobalt, Lime, Magnesia, and Soda.
Craigleith Common Rock.	2·443.	5·7 fluid ounces per cubic foot.	3·8 imperial pints per cubic foot.	4·2 imperial pints per cubic foot.	6·2 imperial pints per cubic foot.	6 ounces boiled on 400 grains of stone for 1 hour 40 minutes, dissolved from it ·35 of a grain.	Dissolved Protoxide of Iron, Lime, and Magnesia.	Dissolved Protoxide of Iron, Peroxide of Iron, Oxide of Cobalt, Manganese a trace, Alumina, Lime, Potassa, and Soda, in small quantity.
Binnie Stone.	2·413.	5·5 fluid ounces per cubic foot.	6·1 imperial pints per cubic foot.	5·5 imperial pints per cubic foot.	7·85 imperial pints per cubic foot.	6 ounces boiled on 400 grains, dissolved ·23 of a grain.	Dissolved Magnesia, Lime, Soda, with a trace of Iron.	Dissolved Iron, Lime, Magnesia, Potassa, and Soda, and Copper.
Gifnock Stone.	2·463.	1·3 fluid ounces per cubic foot.	6·7 imperial pints per cubic foot.	7·4 imperial pints per cubic foot.	8·9 imperial pints per cubic foot.	6 ounces boiled on 400 grains, dissolved ·26 of a grain.	Dissolved Protoxide of Iron, Lime, Alumina, and Magnesia.	Dissolved Silica, Protoxide and Peroxide of Iron, much Lime, Magnesia, Soda, a trace of Manganese, and Cobalt in larger quantity than any of the former.
Partick Bridge Quarry.	2·503.	2·2 fluid ounces per cubic foot.	7·05 imperial pints per cubic foot.	5·11 imperial pints per cubic foot.	7·7 imperial pints per cubic foot.	6 ounces boiled on 400 grains, dissolved ·11 of a grain.	Dissolved Protoxide of Iron, Lime, Magnesia, and Soda.	Dissolved Protoxide of Iron, Peroxide of Iron, small quantity; Lime, Magnesia, Alumina, Silica, and Soda.

COMPOSITION IN 100 PARTS.

	Craigleith Liver Rock.		Craigleith Common Rock.		Binnie Stone.		Gifnock Stone.		Partick Bridge Stone.
Silica,	96·99	...	96·95	...	92·66	...	85·55	...	84·85
Peroxide of Iron and Alumina,	2·95	...	2·30	...	4·88	...	6·55	...	9·35
Water,	·13	...	·23	Organic Matter,	2·23	Carbonate of Lime,	7·90	Carbonate of Lime,	4·65
Lime and Magnesia, Oxide of Cobalt, and Alkalies,	00·00	...	·52	Water,	·23	...		Magnesia,	·45
						Water,	·05	Water,	·08
								Alkalies,	·62
	100·07		100·00		100·00		100·05		100·00

The following Donations to the Library were announced:—

American Journal of Science and Arts, conducted by Professors Silliman and Dana, November 1857. 8vo.—*From the Editors.*

Report on the Observatories of His Royal Highness the Maha Rajah of Travancore, at Trevandrum, and on the Agustier Peak of the Western Ghats. By John Allan Broun, F.R.S., Director of the Observatories. Trevandrum, 1857. 8vo.—*From the Author.*

Natuurkundige Verhandelingen van de Hollandsche Maatschappij der Wetenschappen te Haarlem Tweede verzameling, dertiende Deel. Haarlem, 1857. 4to.—*From the Society.*

Journal of the Statistical Society of London. December 1857. 8vo.—*From the Society.*

Returns of Births, Deaths, and Marriages registered in the eight principal towns of Scotland. November 1857. 8vo.—*From the Registrar-General.*

Journal of the Geological Society of Dublin, Vol. vii., Part 5. Dublin, 1857. 8vo.—*From the Society.*

Thirtieth Annual Report of the Council of the Royal Scottish Academy of Painting, Sculpture, and Architecture. Edinburgh, 1857. 8vo.—*From the President and Council of the Academy.*

Report of the Geological and Polytechnic Society of the West Riding of Yorkshire. 1856–7. 8vo.—*From the Society.*

Memoirs of the Literary and Philosophical Society of Manchester. Second Series, Vol. xiv. London, 1857. 8vo.—*From the Society.*

Meteorological Observations and Essays. By John Dalton, D.C.L. Second edition. Manchester, 1834. 8vo.—*From the Philosophical Society, Manchester.*

A New System of Chemical Philosophy. By John Dalton. Vols. i. and ii., Part 1. 8vo.—*From the Philosophical Society, Manchester.* 8vo.

Publications of the Dépôt de la Marine, viz :—

Collection of Charts.

Description Nautique de la Cote n. du Maroc, par C. A. Vincendon-Dumoulin et C. P. De Kerhallet. Paris, 1857. 8vo.

Instructions pour entrer dans le port d'Alexandrie. Paris, 1856. 8vo.

Instructions Nautiques sur les Mers de l'Inde, par James Horsburgh. Traduites de l'Anglais en 1857, par M. le Predour. 2e edition. Tome deuxième. Paris, 1856. 4to.

Instructions sur la Nouvelle-Calédonie, suivies de Renseignements Hydrographiques et autres, sur la Mer du Japon et la Mer d'Okotsk, par M. Tardy de Montravel. Paris, 1857. 8vo.

Supplément au Pilote de la Mer Baltique. Paris, 1857. 8vo.

Annales Hydrographiques, Recueil d'Avis, Instructions, Documents, et Mémoires, relatifs a l'Hydrographie et a la Navigation, publiés par le Dépôt des Cartes et Plans de la Marine. Paris. 1854–5, 1856, 1857.

Description des Iles et des Passages compris entre la partie nord de l'Ile Luçon et les Iles du Japon. Par M. A. Le Gras. Paris, 1857. 8vo.

Observations Chronométriques et autres, faites en 1853 dans l'Archipel des Pomotous, par M. Parchappe et M. de la Marck. Paris, 1857. 8vo.

Explication et Usage des Wind and Current Charts. Par M. E. Tricault. Paris, 1857. 8vo.

Annuaire des Marées des Côtes de France, pour l'an 1857, publié au Dépôt de la Marine sous le Ministère de M. l'Amiral Hamelin, par A. M. R. Chazallon. Paris, 1856. 16mo.

Phares des Mers du Globe, d'aprés les Documents Français et Étrangers recueillés au Dépôt des Cartes et Plans de la Marine, et publiés par Alexandre Le Gras. Paris, 1856. 8vo.

Manuel de la Navigation dans le Rio de la Plata. Par A. Boucarut. Paris, 1857. 8vo.

Observations sur la Navigation des Paquebots qui traversent l'Atlantique. Paris, 1856. 8vo.

Observations Générales sur l'Ocean Pacifique, par C. Phillipe de Kerhallet, suivies des Prescriptions Nautiques pour echapper aux Ouragans. Deuxième edition. Paris, 1856. 8vo.—*From the Dépôt Général de la Marine.*

Mémoires de l'Academie Impériale des Sciences de Saint Petersbourg. Sixième serie. Sciences Mathématiques et Physiques. Tome vi. St Petersburg, 1857. 4to.—*From the Academy.*

Archives du Museum d'Histoire Naturelle publiées par les Professeurs-Administrateurs de cet établissement. Tome ix., liv[r] 4[ème]. Paris, 1856–7. 4to.—*From the Museum.*

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe, Band xxiii., heft 2, xxiv., hefte 1, 2; Philosophisch-Historische Classe, Band xxiii., hefte 1, 2, 3, 4. Wien, 1857. 8vo.—*From the Vienna Academy of Sciences.*

Denkschriften der K. Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe, Dreizehnter Band. Phil.-Hist. Classe, Achter Band. Wien, 1857. 4to.—*From the same Academy.*

Monday, 4th January 1858.

THE RIGHT REV. BISHOP TERROT, V. P., in the Chair.

The following Communications were read :—

1. On the Structure of the Reproductive Organs in certain Hydroid Polypes. By Dr Allman.

Most of the observations contained in the present communication were made some years ago, and during the last autumn the author had an opportunity of repeating many of them and of adding some others. His object in now bringing them together was, that by being thus placed in possession of sufficient material, we might be enabled to make a useful correlation of the ascertained facts, so as to obtain, if possible, some more general expressions for the phenomena presented.

To arrive at such results, it was found absolutely necessary to introduce some new terms; for in many cases, parts requiring precise notions had no distinctive appellation whatever, while in other cases they had been known by names which convey an entirely false idea of their nature and significance.

Definition of Terms.

The parts of the hydroid zoophytes, on which devolve the office of perpetuating the species by the exercise of a true generative function,

as distinct from simple gemmation, show themselves, as is well known, under the condition of external buds, which are produced in various forms and in various positions on the animal. To these buds, which are truly sexual, being in some cases male and in some female, the author proposes to give the name of *gonophore* (γονος, φορεω).

As an essential portion of the gonophore, we invariably find one or the other of two different kinds of bodies. One of these presents the form of a closed sac, in which a more or less disguised medusoid structure may in almost every instance be detected. For these bodies he proposes the name of *sporosacs* (σπορα, σακκος).

The other differs in no respect from a gymnophthalmous *medusa*, and may conveniently be designated by this name.

Both sporosacs and medusæ contain the immediate products of the generative system, certain individuals of each producing ova, and certain others spermatozoa.

In some cases the gonophore has only a single sporosac, or a single medusa, and these spring directly from the cœnosarc of the zoophyte. In other cases these bodies are numerous, or, if single, do not spring directly from the cœnosarc of the zoophyte, but from a special organ (blastostyle) to be presently described. In the former case, the gonophore may be called *simple* (*Gonophora simplex*); in the latter, *compound* (*Gonophora composita*).

The simple gonophore consists essentially of a sac, which is a mere extension of the ectoderm of the zoophyte invested or not invested by a polypary, and containing within it in some cases a sporosac, in others a medusa. To this sac the author gives the name of *ectotheque* (εκτος, θηκη).

A correct notion of a compound gonophore may be best obtained by referring to some illustrative example such as that afforded by a Laomedea.

In this genus the gonophores are produced near the axils of the ramuli in the form of oval hollow bodies or capsules, invested like the stems and ramuli by a distinct polypary. The axis of the capsule is traversed by an extension of the cœnosarc of the branch in the form of a tubular column, from whose sides there bud forth in some cases numerous sporosacs, in other cases medusæ, each with an ectothecal investment from the column. For this column the author proposes the name of *blastostyle* (βλάστη, στύλος).

In some cases (e.g. *tubularia*) the compound gonophore is desti-

tute of its investing capsule, and then presents merely the condition of a naked blastostyle with its sporosacs (or medusæ ?).

The medusæ, like the gymnophthalmæ generally, consist of an *umbrella* or *mantle* with radiating and circular canals, and with a central projecting organ, in which the stomach is excavated, and which carries the mouth at its extremity. To this central organ the term peduncle has commonly been given, a name which conveys a wrong idea as suggestive of an organ of attachment and support. It is also frequently called the stomach, a term also obviously incorrect, as the true stomach may really occupy but a small portion of the entire organ. Huxley,* seizing, as the author thinks, upon its true significance, names it *polype*, but as it will be more convenient in the present investigations to distinguish it from the ordinary nutritive polype of the colony, it is proposed to speak of it under the name of *manubrium*, a term suggested by its position with regard to the mantle being such as to admit of a comparison with that of the *handle* of an umbrella.

The sporosacs consist of parts which have their strict homologues in the medusæ. These parts will therefore be spoken of under the same names as those of their equivalents in the medusæ.

These preliminary remarks will render easily intelligible the new terms which, after much consideration, the author deemed it necessary to introduce, as the only way by which cumbrous circumlocution can be avoided and precision given to our descriptions; and he proceeded in the next place to describe the structure of the reproductive system in certain species which have in this respect either never received, so far as he is aware, the attention of the comparative anatomist, or which, though studied to a certain extent, still present certain points worthy of attention, but which have hitherto escaped notice.

Hydractinia echinata.

In *Hydractinia echinata* the gonophores are borne upon certain polypes, which, as is well known, are destitute of tentacles and mouth, and differ also in some other respects from the other digestive polypes of the colony.† The gonophores surround the naked stems of

* Lectures on General Natural History in *Medical Times*.

† I have observed in these generative polypes an oval mass nearly filling the cavity of the body. It is developed from the endoderm, and projects from the floor of the cavity. It reminds one of the manubrium of a sporocyst, but is apparently solid.

the polypes at a short distance behind the distal extremity. They may be seen to consist externally of an investing sac (ectotheque), which is a simple extension of the ectoderm of the polype, like it containing thread-cells, and totally destitute of polypary.

Immediately within this is another sac (sporosac), in which the indications of decided structure are very obscure. The second sac immediately invests the mass of ova or spermatozoa which occupy the space between its wall and a well-developed manubrium, which lies in the axis of the sac. The manubrium is a simple diverticulum of the endoderm of the polype, its cavity freely communicating with that of the latter. I could find no evidence of an ectodermal layer upon it. There are no gastrovascular canals.

I have not succeeded in making out any further structure in the gonophore of Hydractinia, which may be assumed as a type of the simple gonophore.

Hydractinia echinata is strictly diœcious, the male and female gonophores being always separated, so as to occupy distinct colonies.

Coryne ramosa.

The gonophores here belong to the simple type. They are borne upon the clavate body of the polypes, where they are scattered irregularly among the tentacula.

They are of a nearly spherical figure, and are attached to the polype by a short peduncle.

The manubrium of the sac is large and simple,—there are no radiating canals.

In the female gonophores the ova are numerous, and may be seen in their young state to be each contained in a very delicate membraneous cæcal tube of a pyriform shape, which closely embraces the ovum, and is attached by its narrow extremity, which constitutes a sort of neck to the base of the manubrium. The germinal vesicle and germinal spot are distinct. As the ova advance towards maturity, they appear to rupture the confining membraneous tube, and then lie free in the cavity of the gonophore.

In the male gonophores, while they cannot be externally distinguished from the female, the sporosac is filled with the spermatogenous cells. These may be seen, under slight compression, to be arranged in radiating lines, which, with a little careful examination, may be traced to the base of the manubrium. That these lines re-

present exceedingly delicate tubules, filled with the spermatogenous cells seems evident, and then they will be the exact equivalent of the pyriform ovigerous tubes of the female. It is quite possible, that in both the male and female sacs, the tubes containing the spermatozoa in the one, and the ova the other, open into the cavity of the manubrium; and thus facility would be at once afforded for the spermatozoa to gain access to the ova. I have never, however, succeeded in demonstrating such a communication.

Indications of the ova and spermatogenous cells being confined at an early period within delicate membraneous tubes may be witnessed in other species, but in no case have I succeeded in demonstrating such a condition so plainly as in the present species.

The spermatozoa have the usual form of caudate corpuscles. The zoophyte diœcious.

Clava multicornis.

In this species, the gonophores are borne upon the clavate body of the polype, just where it passes into the stem, and immediately behind the posterior tentacula. They are compound, each consisting of a cluster of sporosacs attached to a short blastostyle, but are destitute of investing capsule. I have observed in the same colony two kinds of polypes,—the ordinary tentaculiferous polypes, and others destitute of tentacula, and consisting merely of a columnar stem, scarcely clavate at its extremity, and destitute of mouth. The gonophores were borne on both kinds of polypes. The male and female gonophores are separate on distinct colonies.

The manubrium of the sporosac is simple; and there are no radiating canals. In each sporosac (female) there is usually a single ovum, though I have occasionally witnessed two. The germinal vesicle is visible in the ovum, and the process of segmentation may be distinctly traced.

As development proceeds the ovum becomes elongated, and it may be seen to be invested by a proper membrane, apparently structureless. Within this membrane a distinct dermal layer now begins to be differentiated from the ovum; while at the same time a cavity is formed within it, and the embryo may now frequently be seen doubled upon itself. At this stage it is ready to escape from the sporosac, which gives way for its exit, and the embryo may then be seen swimming through the surrounding water by the aid of the minute vibratile

cilia which clothe it entire surface. It is of an elongated conical figure, but very contractile. When fully extended, its surface is smooth; but when contracted, it is thrown into transverse rugæ, which give it a close resemblance to an annuloid animal. The rugæ never show themselves on the thick extremity, which always continues smooth, even in extreme contraction.

Tubularia coronata.

In the *Tubularia coronata* (Van Ben.) the gonophores are borne upon the body of the polype immediately within the posterior circle of tentacula. They consist of a long blastostyle carrying numerous sporosacs, and are destitute of investing capsule. The zoophyte is diœcious. In referring to my notes of this species made some years ago, but which I have not since had an opportunity of verifying, I find that the phenomena presented by the development of the ovum point to a type quite different from what prevails in that of the sertularian zoophytes, and in Clava, Coryne, &c. In the present species, the embryo is not the result of a transformation of the entire ovum, as in the instances just mentioned, but is produced from a definite portion of the vitellus, the remainder of the vitellus being absorbed by the developing embryo.

The embryo itself is developed on an entirely different plan from that of the sertularidans, &c. Instead of presenting the form of an elongated ciliated cone, destitute of all appendages, as in the latter, it assumes here somewhat that of two short, thick cones placed base to base, surrounded at the place of contact by a circle of long filiform tentacula slightly thickened at the ends.

In this condition it leaves the sporosac, and by the aid of its long tentacula, moves about freely in the water.

As development proceeds, and apparently before it had left the gonophore, a mouth is found upon one apex of the double cone, and round this mouth, a circle of short tentacula afterwards sprout out. In a further stage, we find that the opposite apex has become elongated into a hollow peduncle, by which the young Tubularia permanently fixes itself to some solid body, while the clavate condition of the extremities of the tentacula entirely disappear, and these organs acquire a uniform thickness throughout.

Little more is now needed to bring it into the form of the adult Tubularia.

Laomedea flexuosa. Hincks.

In this zoophyte the gonophores are of an oval form, generally truncated at the summit. They consist of a blastostyle, with sporosacs and investing capsule.

The blastostyle is in the form of a cylindrical column expanded into a sort of head at its distal end, and having a distinct ectoderm and endoderm inclosing a central cavity, which freely communicates with that of the cœnosarc of the polype.

From the sides of the column numerous sporosacs bud forth, carrying with them an ectothecal investment from the ectoderm of the blastostyle, and, being more mature the nearer they approach to the distal extremity of the blastostyle. They possess a large simple manubrium, and are destitute of gastrovascular canals.

The whole is surrounded by the oval capsule. The formation of this capsule may be observed by watching the growth of the gonophore. In the young state of the gonophore one or more lacunæ may be seen in the ectoderm of the blastostyle. These become confluent and soon extend round the whole blastostyle, thus separating the ectoderm into two distinct layers by a true process of chorization. The inner layer still remains adherent to the endoderm; but the outer layer recedes farther and farther from the central column, to which it remains directly attached only at the proximal and distal ends, thus forming the walls of an external capsule whose axis is occupied by the blastostyle, and whose cavity is nothing more than a large lacuna. Into this lacuna the sporocysts bud forth from the sides of the blastostyle. While the gonophore is yet young numerous irregular fleshy bands may be seen stretching across the cavity from the blastostyle to tho external wall. These bands are the remains of the original union between the two layers into which the ectoderm of the blastostyle has split. They are generally torn, and disappear as the capsule, increasing in size, becomes more and more widely separated from the blastostyle; but they are also occasionally more or less visible in the full-grown gonophore. In the meantime, the ectodermal layer, thus separated from the blastostyle, becomes invested by a distinct chitinous polypary; and after the capsule has acquired its full size, this ectodermal layer generally disappears along with the connecting bands just described, and the

capsule is now solely represented by the chitinous secretion of its original wall.

Each sporosac (female) produces a single ovum in which the germinal vesicle and spot are distinctly visible. The segmentation of the vitellus can be easily followed; and as the segments become smaller and more numerous, a nucleus may be distinguished in each. The ovum at the same time increases in size, and the manubrium of the sporosac becomes more or less displaced. After the disappearance of the mulberry-like condition, an external dermal layer becomes distinctly differentiated. It is composed of elongated cells placed perpendicularly to the surface, and may be seen to enclose a minutely granular mass. The ovum, at the same time, becomes considerably elongated, and may be soon seen doubled on itself. It now acquires cilia on its surface, and is ready to escape as a free embryo from the sporosac, which accordingly becomes ruptured to allow of the exit of the embryo, which ultimately gains its final freedom through the summit of the capsule. The embryo now moves freely, by the aid of its ciliated surface, through the surrounding water. It is of a conical or pyriform figure, but very contracted and mutable. Its interior may be seen to be hollowed out into a cavity, but as yet no mouth can be demonstrated.

I have not yet succeeded in witnessing the change of the locomotive to the fixed state of the polype, but it is doubtless similar to what has been observed in the allied forms.

The male capsules and sporosacs resemble the female so closely as only to be distinguishable from them by an examination of the contents of the sacs. These contents consist of a mass of spermatogenous tissue, which replaces the single ovum of the female.

The spermatozoon consist of caudate corpuscles, about $\frac{1}{5000}$ of an inch in diameter.

Laomedea flexuosa is strictly diœcious, the male and female gonophores always occurring on separate colonies.

Antennularia antennina.

The gonophores in *Antennularia antennina* are borne upon the upper side of the short processes which, springing in verticels from the main stem, give support to the polypiferous ramuli.

Each process carries a single gonophore, which is of an oval form, and presents, as it approaches maturity, a subterminal aperture directed towards the main stem of the zoophyte.

The gonophore is constructed on the compound type, and presents a blastostyle, sporosacs, and investing capsule. The sporosacs are given off near the base of the blastostyle : there is usually but a single one ; occasionally, however, two may be observed in one gonophore. The manubrium is well developed, but there are no gastro-vascular canals.

In the female sporosac a single ovum makes its appearance. This at first occupies but a small portion of the cavity of the sporosac, and permits the long manubrium to be easily seen, but as it grows it entirely fills the sporosac, and ultimately, by its pressure, causes the absorption, first of the walls of the sporosac, and at last of the manubrium and blastostyle, until nothing remains but the external chitinous envelope of the capsule, with the ovum floating freely within it.

I have also frequently observed floating along with the ovum in the gonophore, a small free sporosac with well developed manubrium, but containing neither ova nor spermatozoa. It was probably a bud, formed like the ordinary sporosacs from the blastostyle, but never developing within it the generative elements.

The male gonophores resemble the female in all respects except in the contents of the sporosacs, which are here spermatozoa, instead of ova. In the young gonophores the sporosac is filled with semi-fluid contents, which are found to be composed of a mass of cells, frequently with secondary cells, "vesicles of evolution," in their interior. The secondary cells, whether free or contained in the mother-cells, are filled with a corpuscular fluid, in the midst of which may generally be demonstrated a larger corpuscle, which under the action of acetic acid is rendered especially apparent as a bright spherical nucleus.

The contents of the sporosac, which were at first sufficiently transparent to admit of the manubrium being clearly seen in the midst of them, become more and more opaque as the gonophore advances to maturity, and finally completely conceal the peduncle. If the contents be now liberated by rupture of the sporosac, they will be found to consist, partly of free active spermatozoa, and partly of cells (vesicles of evolution), with the spermatozoa still confined in them.

The spermatozoa consist of a minute oval or rather pyramidal body with a delicate caudal filament. In each of the vesicles of evolution there may be distinctly seen a somewhat elongated nucleus which is the body of the spermatozoa, as yet confined in its vesicle of evolution, and is plainly derived from the original spherical nucleus of the vesicle.

The ovum, from the earliest period at which I have observed it, appears as an opaque yellowish body. From an early stage it may be seen to consist of a mass of minute spherical cells filled with a yellow fluid, while the whole is enveloped in a delicate vitelline membrane. In the young ovum the germinal vesicle may be seen as a single large spherical cell included in the midst of the other contents, whose opacity, however, makes it necessary to subject the ovum to compression before we can bring into view the germinal vesicle, which may then be completely isolated as a separate cell on the field of the microscope. In the more advanced ovum the germinal vesicle has entirely disappeared; but I did not succeed in satisfactorily tracing any very distinct segmentation, owing, doubtless, to the unusual opacity of the ovum. The whole ovum becomes gradually converted into the embryo. As the time approaches when it is to leave the gonophore, we find it capable of changing its form by slow contractions, and it soon escapes by the aperture of the gonophore, and enters on the external world as a free embryo.

It is now of a more or less conical form, though continually changing its shape by slow contractions. By this time the ectoderm and endoderm are both differentiated, and a central cavity has already made its appearance; but there is as yet no trace of a mouth; thread-cells, the characteristic product of the ectoderm, are copiously developed in it, and its surface is clothed with very minute cilia, which, however, in all the examples I examined, were so enveloped in a mucous investment as to impede their action, and render them powerless as organs of locomotion. The embryo creeps about slowly upon the sides of the glass jar in which it is confined, avoiding the light side of the vessel.

After enjoying for a period its locomotive stage, the embryo fixes itself to the side of the jar by one extremity (the wider ?) which then extends itself by means of radiating elongations into a little disc of a regular stellate form. From the centre of the free surface of the disc a cylindrical column now rises perpendicularly, and

the whole becomes invested, at this stage, with a delicate transparent polypary. The column continues to grow longer, and now presents at intervals a shallow constriction. The cœnosarc which fills its axis is at first a simple tube with its endoderm and ectoderm ; but it soon becomes resolved into the distinct tubules which characterise the cœnosarc in the stem of the adult.* The currents in these tubules are very evident, but are quite independent of one another—sometimes they may be all seen running down, sometimes running up; some down in one or two tubes, up in the others; sometimes the current will be very active in some, and at rest in the others.

From the basal disc small tubular filaments are prolonged to constitute the commencement of the matted root-like base of the mature colony.

From the parts of the stem where the constrictions show themselves, short, thick processes are shot out alternately at each side, so that the stem now presents a slightly zigzag form. From the upper side of each process a pair of the peculiar little cup-like organs, characteristic of the adult zoophyte, are produced, and on its extremity the first joint of the polypiferous ramulus makes its appearance. This joint is soon followed by another, and the ramulus gradually elongates itself by the necessary multiplication of joints. We have now a condition of the zoophyte very remarkable from the fact of its polypiferous ramuli presenting a strictly alternate arrangement, no tendency to the verticellate disposition of these ramuli in the adult being yet apparent.

Beyond this point I have not been yet able to follow the development of the young Antennularia.

* In the main stem of the adult, the disposition of the cœnosarc is very peculiar. Instead of forming a single tube, it consists of numerous separate tubules, each with its ectoderm and endoderm. The tubules lie close upon the polypary, and leave an unoccupied space in the axis of the stem. They are connected to one another by an extension of the ectoderm, which thus forms a continuous lining of the polypary. In some parts the tubules of the cœnosarc run straight and parallel to the axis of the stem, in others, they are more or less curved, and frequently connected by transverse but irregular branches, so as to present a reticulated arrangement. The motion of the contents of the tubules can be distinctly witnessed in them. This complex structure of the cœnosarc disappears in the ramuli, the separate tubules here giving place to the ordinary simple tube.

Campanularia caliculata. Hincks.

I obtained this species on the 24th September 1857, from rock pools near low-water mark in Courtmasherry Harbour, with the gonophores. I obtained it afterwards in considerable quantities towards the end of the following October, from the same locality, adhering to *Delesseria sanguinea*, brought up on the long lines of the fishermen, but it was then almost entirely destitute of gonophores.

The gonophores are borne on the creeping stolon, to which they are attached by a short peduncle. They are of an irregular oval shape, with the summit truncated.

The blastostyle, in every case I examined, carried one large sporosac, which occupied about the upper two-thirds of the gonophore, and one smaller, and less developed, springing from the blastostyle near its base.

The sporosacs present some interesting peculiarities. The manubrium is obsolete, but four gastrovascular canals extend from the base of the sac to the summit, where they terminate in blind extremities. These canals send out short, lateral, alternate branches between every two of which, in the female sporosacs, an ovum is embraced. The germinal vesicle and spot are distinctly demonstrable, and the ovum is itself invested by a delicate membranous sac, which confines it in the sinus between the branches of the gastrovascular canals.

I had no opportunity of observing the development of the ovum.

Plumularia pinnata.

The gonophores, which are compound, are of an oval form, sometimes smooth, sometimes with a few irregular spiny longitudinal ridges. They are borne on the central stem or rachis, chiefly towards its attached end.

The blastostyle is but moderately developed, and carries usually only a single sporosac; but I have occasionally met with two or three. The manubrium, after advancing for a short distance into the sporosac, becomes much, but irregularly, lobed. Into these lobes the cavity of the manubrium is continued, and they may be fairly taken to represent the gastrovascular canals, which have no further equivalent in this species. In very young sporosacs the manubrium appears quite simple, but as the sporosac advances towards maturity the lobed condition becomes apparent.

The ova vary in number. I have occasionally found but a single one in each sporosac, though most usually from three to eight. They present the germinal vesicle and germinal spot, and may be observed to undergo segmentation.

The ciliated embryo is of the usual conical form. When about to change to the fixed state it attaches itself by one extremity, which becomes extended in the form of a four-lobed star, resembling a Maltese cross, from whose centre rises perpendicularly the primordial stem of the future zoophyte, at first in the form of a small cylindrical process, which elongates itself more and more, becoming at the same time invested with a delicate polypary.

We next find that on one side of the young stem a cell is formed in which the cœnosarc becomes developed into a polype.

Beyond this point I had no opportunity of observing the progress of development.

I have found the male gonophores on the same stem with the female, so that here the usual diœcious condition is departed from. The male gonophores are smaller and much less numerous than the female. The manubrium is less distinctly lobed, and is surrounded by a mass of spermatozoa instead of ova. The spermatozoa consist of a minute, somewhat pyramidal, body about $\frac{1}{5000}$ of an inch in diameter, with a caudal filament. They are developed in vesicles of evolutions, from which they seem to be produced by a transformation of the nucleus.

I obtained the *Plumularia pinnata* in abundance with the reproductive capsules, during the months of September and October, in rock pools near low-water mark at Lisnaleen.

Plumularia cristata.

Plumularia cristata is very remarkable, by a singular arrangement destined for the protection of its gonophores.

These are borne on certain peculiarly metamorphosed ramuli, which we must be careful not to confound, as has hitherto been done, with the proper gonophores of other zoophytes, and for which, believing it therefore necessary to give them a special name, I propose the term *corbulæ*, suggested by their basket-like form. In these corbulæ the proper gonophores are contained. The peculiar metamorphosis of the ramulus, which results in the formation of a corbula, consists in its developing from its sides alternate leaflets,

which have their edges at first entire, but which afterwards become deeply serrated. As the leaflets increase in size they direct themselves vertically from the upper surface of the ramulus, and those of one side arch over, so as to approach those of the opposite. They are at first free, but they afterwards become intimately united at their edges, while those of one side ultimately coalesce with those of the other by their summits, and thus form a completely closed receptacle. Each leaflet contains a cavity which is only a prolongation of that of the ramulus.

In this receptacle the gonophores are produced. They spring from the upper side of the metamorphosed ramulus at the point where the leaflet leaves it, and take the place of the polype cells on an ordinary ramulus. They begin to be produced at an early stage of the corbula, and may be easily examined in the young corbula while yet open.

The metamorphosed ramulus generally remains unchanged for a short distance from its origin, and here may be seen bearing one or two ordinary polype cells.

About twelve gonophores are generally contained in each corbula; they are of the simple type, of a regular oviform figure, and are invested with a delicate extension of the polypary. The sporosac has a well-developed manubrium, which is quite simple, and extends nearly from the base of the sac to the summit. I have not found more than a single ovum in the female sporosacs I examined. In the male sporosacs, the cavity is filled with the spermatogenous tissue.

General Conclusions.

A comparison of the different forms of gonophore presented by the several species just described, and by some others not included in the present paper, shows that they are referable to three distinct types.

1. The *simple gonophore*, such as we find in Hydractinia, Cordylophora, &c.

2. The *naked compound gonophore* consisting of blastostyle and sporasacs, but destitute of investing capsule. Examples of this form are found in Tubularia and Clava.

3. The *capsular compound gonophore*, consisting of blastostyle and sporosacs, and having the whole invested by a distinct capsule. This type occurs in Campanularia, Laomedea, &c.

The gonophores may present a further remarkable condition, in having a number of them grouped together and included in a common receptacle formed by modified ramuli, as in *Plumularia cristata.*

Besides the above types, certain interesting modifications of form are presented by the sporosacs.

In these the manubrium may be

1. a simple diverticulum from the cœnosarc or the blastostyle, as in Hydractinia, Laomedea, &c.

2. It may be irregularly lobed, as in *Plumularia pinnata.*

3. It may send off from its base true gastrovascular canals, as in Cordylophora.

4. It may be completely suppressed, while well-developed gastro-vascular canals spring from the base of the sporosac. This condition we find in *Campanularia caliculata.*

In the development of the embryo, we are probably justified in distinguishing two distinct types, though further observations will be needed before we can consider the generalization involved in this assertion as absolutely established.

1. The embryo may be developed directly from the whole vitellus, and will then always(?) present the form of a ciliated conical body.

2. The embryo may be developed directly from only a part of the vitellus, and will then always (?) present the form of a non-ciliated actiniform body.

2. On the Focal Adaptation of the Eye in Man and some Animals. By Dr James Black, F.G.S. Illustrated by enlarged diagrams.

After several introductory observations on the refractive condition of the human eye in infancy, in the prime of life, and in old age; and also in some tribes of artizans, in shepherds, and in mariners, with notices of the focal adjustment in the eyes of oxen, common fowls, and in fishes, as the cod and haddock, the author examined the different theories which have been advanced to account for this adapting power, and expressed his strong opinion that the external muscular apparatus was the principal and initiating agent.

3. Note on the Black Lustrous Varnish of ancient Pottery. By John Davy, M.D., F.R.SS. L. & E., &c.

So far as my reading extends, the nature of the black varnish of the ancient Greek and Etruscan vases is still undetermined.

From the experiments I have made, operating on very small quantities, abraded from vases which were taken from tombs in the Ionian Islands, I have been led to the conclusion, that it is a vitreous matter, coloured by black oxide of iron, probably mixed with particles of metallic iron, to which its peculiar lustre may be owing.

It is, I find, of the hardness of glass, brittle and opaque. In powder or small fragments, it is powerfully attracted by the magnet. Before the blow-pipe it is fusible, its colour remaining unchanged, however powerfully it may be urged by the flame. It is insoluble in the nitric and muriatic acids, and also in the nitro-muriatic, and without change of colour; but, when fused with boracic acid, and then acted on by muriatic acid, its colouring matter is dissolved, siliceous matter remaining, and the solution is slightly precipitated by ammonia.

Considering this glazing as a compound of silica and of an alkali, or of an alkaline earth, coloured by iron, it may, I presume, be inferred, that it was applied to the earthenware in the form of a paste, and that the vessels were afterwards subjected to a temperature sufficiently elevated to melt the paste, and convert it into glass, but not high enough to fuse the substance of the pottery, which I find is fusible at a very high temperature. It may also, I think, be inferred, that the ferruginous colouring matter was mechanically mixed with the paste, before being applied;—an inference I am led to, from the circumstance, that where the varnish is very thin, it is no longer opaque,—the red colour of the clay is seen through it; and, on minute inspection, with a magnifying glass, evidently owing to a partial absence of the black colouring matter.

Probably the ancient vases, of superior quality, in which the red colour of the clay is so finely contrasted with the shining black of the varnish, were subjected to heat, in close vessels, as the Turkish pipe-bowls, which are of similar material, and of the same pure red colour, are baked at present: they are placed in a dome made of clay, from which the air is excluded, the fire being heaped up around.

The extraordinary durability of this varnish, as remarkable as its beauty, entitles it, I cannot but think, to consideration; and it is chiefly with the hope of calling attention to the subject, especially the attention of those engaged in our porcelain manufactories, now carried on with so much science and taste, that I venture to communicate this note to the Society.

ALEXANDER BRYSON, Esq.,

was duly elected a Fellow of the Society; and

W. H. FOX TALBOT, Esq., F.R.S.,

was elected an Honorary Fellow of the Society.

The following Donations to the Library were announced:—

The Canadian Journal of Industry, Science, and Art, conducted by the Canadian Institute. New Series, No. 12. Toronto. 8vo. —*From the Canadian Institute.*

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt. 1856, No. 4; 1857, No. 1. Wien, 1856–7. 8vo.—*From the Institute.*

Proceedings and Papers of the Historic Society of Lancashire and Cheshire. 1848–54. Liverpool. 8vo.—*From the Society.*

Address of Lord Wrottesley, the President, delivered at the Anniversary Meeting of the Royal Society on 30th November 1857. London, 1857. 8vo.—*From the Royal Society of London.*

Papers read at the Royal Institute of British Architects. Sessions 1855–6 and 1856–7. London. 4to.—*From the Institute.*

Return of Births, Deaths, and Marriages, registered in the eight principal towns of Scotland. November 1857.—*From the Registrar-General.*

Quarterly Journal of Agriculture, and Transactions of the Highland and Agricultural Society. January 1858.—*From the Society.*

Transactions of the Pathological Society of London. Vol. viii. London, 1857. 8vo.—*From the Society.*

Medico-Chirurgical Transactions, published by the Royal Medical and Chirurgical Society of London. Vol. xl. London, 1857. 8vo.—*From the Society.*

Monday, 18th January 1858.

THE RIGHT REV. BISHOP TERROT, V.P., in the Chair.

The following Communications were read:—

1. On the Mechanism of the Knee Joint. By Professor Goodsir.

After alluding to the comparatively superficial manner in which physiologists, with the exception of the brothers Weber, have hitherto investigated the structure and movements of the joints, the author gave an abstract of the general results which he had formerly obtained in an examination of the knee-joint, made with reference to Meyer's valuable observations. He had found that, as stated by Meyer, the thigh and leg rotate on one another in opposite directions,—at the close of extension, and at the commencement of flexion; and that the co-ordinated movements in the patella, the ligaments, and muscles correspond generally with the account given by that observer; but in addition he had ascertained what had previously escaped notice,

1. That the articular surfaces of the femur, tibia, and patella are not continuous but faceted surfaces.

2. That in consequence of this faceted configuration, and the peculiar manner in which the opposite articular surfaces move on one another, they are in no position of the joint congruent throughout, but gape more or less in different parts of their extent.

3. That in addition to their lubricating function, the so-called Haversian glands, or fatty folds of the synovial membrane, are arranged with reference to the resulting gaps or chinks between the opposite articular surfaces, each gap, as it opens out, being simultaneously occupied by the fatty synovial pad provided for it, and which is forced or dragged into the chink, and pulled or forced out again by special arrangements.

The author next proceeded to state, as introductory to the mechanism of the knee-joint, the results which he had latterly obtained in his examination of other diarthrodial articulations.

1. All diarthrodial surfaces are faceted, and consist of areas of distinct configuration and movement.

2. These facets and areas are marginal or terminal, and central or acting—the former giving steadiness to the action of the joint, and supplying surface on which it rests securely at the opposite ex-

tremities of its movements—the latter more especially regulating the movements themselves, and presenting the greatest extent of surface, which again consists of a moiety for each half of the movement, the one portion breaking contact, while the other is acting, and *vice versa.*

3. Even the acting facets of opposite articular surfaces are only congruent at one particular stage of their movement.

4. The movements of opposite diarthrodial surfaces upon one another appear to be in every instance a combination of gliding and rolling—the amount of the former being directly, and that of the latter inversely, as the congruence of the opposite articular surfaces.

Referring to the important simultaneous discovery recently made by Langer and Henke, and verified by Meissner, of the screwed structure of certain joints, the author proceeded to state, that he would in a future communication on the ancle and tarsal joints give the grounds on which he had come to the conclusion,

1. That in all the joints hitherto examined the screw is developed on a conical surface, and not on a cylindrical one, as is held by Langer to be generally the case.

2. That not only is it impossible accurately to prolong the screwed surface by uniting longitudinally a number of casts made from it, but that neither the original surface nor its cast admits of being screwed along the mould, with continued congruity of surface.

3. That this incongruity depends, in the first place, on the screwed surface being conical, and on the rapid increase in the obliquity of the thread; and, in the second, on its consisting of at least two areas, each being a portion of a conical screw.

After exhibiting prolonged screws, made according to Langer's method, from the upper articular surface of the astragalus in the horse, panther, lion, and human subject, the author proceeded to state, that, induced to re-examine the knee-joint from this fresh point of view, he had ascertained, in the first place, that the path described by any point in the thigh, when the leg is fixed, and the knee put through its movements, does not lie in the presumed plane of flexion and extension, as it would do if the profile curvatures of the femoral condyles were circular arcs, or logarithmic spirals, according to the ordinary view, or that of the brothers Weber; neither does the point in the upper part of its course describe the arc of a circle in a plane oblique to that in which it must afterwards move, if Meyer's

observations be absolutely correct, but on the contrary describes a helix, consisting of at least two parts, an upper and a lower. This observation led the author to the detection of two screw combinations in the knee-joint; and by a careful study of the anatomical relations of the elements of the articulation he came to the following conclusions,

1. The knee-joint consists essentially of two conical screw combinations.

2. One of these screw combinations forms the anterior, the other the posterior part of the joint.

3. The axes of these screw combinations, instead of being at right angles to the so-called plane of flexion and extension, as in the ankle and elbow joints, are parallel, or nearly so, to the axis of the limb, the vertices of the fundamental cones being directed upwards.

4. The femoral condyles form the concave; the tibial condyles, intercondyloid spine, and crucial ligaments, the convex elements of each screw combination.

5. Each of these screw combinations is double-threaded; the breadth and obliquity of the threads rapidly increasing from vertex to base.

6. A comparatively limited extent of the convex element of each combination is retained, so that the larger extent of the concave element employed moves on the former by a combination of gliding in the direction of the screw, and of rolling.

7. The gliding in the direction of the screw is due partly to the screwed configuration of the opposite cartilaginous surfaces; partly to the peculiar mode of attachment of the crucial ligaments.

8. In consequence of the peculiar attachments of the successive fasciculi of the crucial ligaments, these fasciculi, after having in succession co-operated in producing the gliding movement in the direction of the screw, bend over, and thus permit the rolling movement.

9. The path described by any point in the thigh or leg during flexion or extension of the knee-joint is a helix, produced by the movements of the two screw combinations in succession: but modified by the rolling.

10. The anterior screw combination is left-handed in the right knee, and right-handed in the left.

11. The posterior screw combination is right-handed in the left knee, and left-handed in the right.

12. The two screw combinations in each knee are united, so that the anterior half of the anterior combination, and the posterior half of the posterior, are alone retained; while the external femoral and tibial condyles respectively consist of the united basal portions of one of the threads in each combination; and the inner condyloid surfaces respectively of portions of the other thread in each, but consequently towards the vertices of the fundamental cones.

13. When the knee-joint is fully extended, its anterior screw combination is screwed home, and its posterior is unscrewed; when it is completely flexed the anterior combination is unscrewed, and the posterior screwed home.

2. On the Exhibition of both Roots of a Quadratic Equation by one Series of Converging Fractions. By Edward Sang, Esq.

It had been long known that every periodic continued fraction expresses the root of a quadratic equation, and in 1808 M. Lagrange demonstrated the converse proposition, that the roots of every numerical equation of the second degree may he expressed by such fractions. The subject has since been examined by M. Legendre in his "Theorie des Nombres," and also by Barlow, and the laws discovered have been applied to the resolution of certain classes of diophantine problems of the second order.

The writers on this subject have considered the two roots of such equations separately, and have regarded the two series of fractions which converge to them as distinct. In the development of these fractions the quotients become periodic after one or more terms have been found; resembling in this way the digits of a recurring decimal fraction of which some of the earlier terms are not recurrent. The object of this notice is to show that these two series form in reality parts of one general series, the multipliers of which are periodic throughout. To this particular form of series it is proposed to give the name *duserr*, from the Persian دوسر *two heads*, or two leaders.

The character of the duserr progression was exemplified by considering the roots of the equation—

$$5x^2-32xy+31y^2=0.$$

On approximating to these roots by the known process, the quotients

$$1\,,5\,;3\,,1\,,4\,;3\,,1\,,4\,;\ \&c.$$

$$\text{and } 5\,;4\,;1\,,3\,;4\,,1\,,3\,;\ \&c.,$$

are found, whence the two progressions—

$$\begin{array}{cccccccc}
1 & 5\,; & 3 & 1 & 4\,; & 3 & & \\
\frac{1}{0} & \frac{1}{1} & \frac{6}{5} & \frac{19}{16} & \frac{25}{21} & \frac{119}{100} & \frac{382}{321} & \&c.
\end{array}$$

$$\begin{array}{cccccccc}
5\,; & 4 & 1 & 3\,; & 4 & 1 & & \\
\frac{1}{0} & \frac{5}{1} & \frac{21}{4} & \frac{26}{5} & \frac{99}{19} & \frac{422}{81} & \frac{521}{100} & \&c.
\end{array}$$

If, instead of proceeding forwards in either of these progressions, we compute backwards, using only the recurring quotients, we produce the other progression, thus :—

$$\begin{array}{ccccccccccccc}
 & & 3 & 1 & 4 & 3 & 1 & 4 & 3 & 1 & 4 & & \\
\&c. & \frac{-99}{-19} & \frac{26}{5} & \frac{-21}{-4} & \frac{5}{1} & \frac{-1}{0} & \frac{2}{1} & \frac{1}{1} & \frac{6}{5} & \frac{19}{16} & \frac{25}{21} & \frac{119}{100} & \&c.
\end{array}$$

The case of the roots being on different sides of the zero, was exemplified by means of the equation

$$7x^2-8xy-102y^2=0$$

which are contained in the two-headed progression—

$$\begin{array}{ccccccccccc}
 & & 7 & 2 & 3 & 7 & 2 & 3 & 7 & & \\
\&c. & \frac{171}{-52} & \frac{-23}{7} & \frac{10}{-3} & \frac{-3}{1} & \frac{1}{0} & \frac{4}{1} & \frac{9}{2} & \frac{31}{7} & \frac{226}{51} & \&c.,
\end{array}$$

and that case in which the roots lie equally on either side of the zero by the equation

$$10x^2-53y^2=0$$

the roots of which are contained in

$$\begin{array}{ccccccccccc}
 & & 4 & 3 & 3 & 4 & 3 & 3 & 4 & & \\
\&c. & \frac{99}{-43} & \frac{-23}{10} & \frac{7}{-3} & \frac{-2}{1} & \frac{1}{0} & \frac{2}{1} & \frac{7}{3} & \frac{23}{10} & \frac{99}{43} & \&c.
\end{array}$$

It was remarked that the progressions indicate certain peculiarities in these continued fractions. First, that the order of recur-

rence in the quotients obtained for one root is inverse of that for the other root of the quadratic; second, that in continued fractions which express the square root of any rational fraction, the order of recurrence is symmetric within each period; and third, that the last quotient of the period must be double of the first or integer part of the root.

It was also observed, that the progressions may be separated into as many progressions as there are members in the period, each progression proceeding as with a single repetend. The consideration of this branch of the subject was said to lead to the formation of series representing the impossibility of the roots when the square of the middle coefficient is less than four times the product of the extreme ones, and when these have the same sign.

The following Gentleman was duly elected a Fellow of the Society:—

Frederick Field, Esq., Chili.

The following Donations to the Library were announced:—

Scheikundige Verhandelingen en Onderzoekingen uitgegeven door G. J. Mülder. Eerste deel, derde stuk. Het Bier scheikundig beschouwd door G. J. Mülder. Rotterdam, 1857. 8vo. —*From the Author.*

Flora Batava, 182 Aflevering. Amsterdam. 4to.—*From the King of Holland.*

A Catalogue of 3735 Circumpolar Stars, observed at Redhill in the years 1854, 1855, and 1856, and reduced to mean positions for 1855·0. By Richard Christopher Carrington. London, 1857. Folio.—*From the Lords of Admiralty.*

Denkschriften der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe, Zehnter und eilfter bände.—*From the Vienna Academy.*

Annales de l'Observatoire Physique Central de Russie. Par A. T. Kupffer. Année 1854. St Petersbourg, 1856. 4to.—*From the Observatory.*

Bulletin de la Société Vaudoise des Sciences Naturelles. Tome v., No. 41. Lausanne, 1857. 8vo.—*From the Society.*

Proceedings of the Natural History Society of Dublin, for the Session 1856–57. Dublin, 1857. 8vo.—*From the Society.*

The Assurance Magazine and Journal of the Institute of Actuaries. Vol. VIII., Part 4. January 1858. 8vo.—*From the Institute of Actuaries.*

Isothermal and Rain Charts, illustrating the Climatology of the United States, and of the Temperate Latitudes of the North American Continent. By Lorin Blodget. Philadelphia, 1857. Folio.—*From Professor Henry D. Rogers.*

Monday, 1*st February* 1858.

SIR DAVID BREWSTER, V.P., in the Chair.

The following Communications were read:—

1. On the Form and Origin of the Symbols on the Ancient Sculptured Stones of Scotland. By Dr Wise.

In continuation of his former essay on the sculptured stones peculiar to the north-eastern portion of Scotland, the author produced, for the inspection of the Society, two specimens of the Buddhist *dorje*, which he considered to be the prototype of the well-known *spectacle-ornament*, found on no fewer than thirty-four of those stones; and, in twenty-nine instances, in combination with zig-zag lines, the symbol of power. The *dorje* is a portable instrument, which represents the two original members of the Buddhist Triad, spirit and matter, and is employed by the Buddhist priests of Tartary, &c., in the performance of religious worship.

The *dorjes* which were exhibited consisted each of two hollow-ribbed spheres, or ovals of brass, united by a handle, two inches long, of the same metal. When represented on the black board, with its axes or poles towards the spectator, one of the *dorjes* resembled exactly the spectacle-ornament on the larger Aberlemno stone in Forfarshire.

The *dorje* is considered indispensable to the Buddhist priest, during certain religious ceremonies. It is held over the head of the kneeling penitent in the act of absolution; and a sacred bell (likewise exhibited), having at the extremity of its handle a ball similar to those of the *dorje*, is rung. In some temples direct worship is paid to a *drje* kept for that purpose.

It is well known that the Buddhist priests were enjoined to spread themselves over the world for the propagation of their faith, and that they speedily overran, and converted, a large portion of the great nations of Asia. As they are proved to have been known in Europe, during the second and fifth centuries, it appears probable that the may have reached Scotland by means of Phœnician ships. In this case they would introduce the *dorje*,—the indispensable symbol of their faith,—and would naturally incise the figure of it upon the upright stones, possibly erected at an earlier period, as objects of veneration: And in such representations, as the priest was not present to complete the sacred symbolism of the Buddhist faith, by representing the third member of the Triad, or organized matter, the result of the interaction of the two former members, this was represented by the figure of an elephant, or a bird, or the segment of a circle, well-known as the *cockit-hat-ornament*, &c.

Various instances were given, in which the Buddhists borrowed religious ceremonies from the ritual of the Latin Church. A similar combination appears to have taken place in Scotland, on the introduction of Christianity; with this difference, that there the faith and the symbol of the cross eventually prevailed over those of Buddhism. For a time, however, the old symbol of the deity, the *spectacle-ornament*, or, as it ought in the author's opinion to be styled, the *dorje symbol*, was retained along with the emblems of Christianity. From the similarity to each other, of the figures on the sculptured stones of the north-eastern part of Scotland, they appear to have been executed by the same Christian community, and that the very earliest in that part of the island; the community, in fact, to which Tertullian refers, in the third century, as inhabiting those parts of Britain never conquered by the Romans, and which, after gradually superseding the more ancient belief, flourished in the great kingdom of the Picts.

2. Notes on the Structure of Amphora, a genus of Diatomaceæ, and the diagnosis of its species. By Dr Walker Arnott.

When Linnæus said that all objects of natural history must have a *specific name*, he did not mean a *trivial* name (which was not then invented), but what is called a short, distinctive character, otherwise

it is not imperative on others to adopt the trivial name imposed, or recognise it in any way. The want of short characters (intended to place clearly before the mind the few essential points of difference between supposed new and already known forms or species) cannot be supplied by figures or diffuse descriptions of the entire object, as these leave quite in the dark the precise *marks of distinction* observed by the writer, if such actually existed. In composing either a defining character or a detailed description, it is also necessary to use the technical language of that science. The author, in referring to Dr Gregory's paper on the Diatomaceæ of the Clyde, published in the last part of the *Transactions*, regretted that this patient observer had neglected these rules, and thus enveloped his whole memoir in an almost impenetrable cloud; thus not only precluding himself from claiming any right of priority of names, in the event of the same form being afterwards correctly characterized by another under a different name, but depriving the paper itself of its claims to be considered a scientific one. The same unfortunate cloud rendered it difficult to understand what Dr Gregory's actual views of the structure of Amphora were; although, from expressions used by him, he appears to enunciate the theory, that what other writers call a simple frustule, ought to be considered as a double one.

The author, to make this more intelligible to those not generally interested in such pursuits, defined what the structure of a diatom was, as is explained by Smith in his Synopsis of British Diatomaceæ; and indicated the mode of proving, by Canada balsam, whether the frustule was single or double. When tested in this way, what was *commonly* called a simple frustule was found to be actually so, and of one cell, so that Dr Gregory's hypothesis was untenable. The structure of the genus Amphora appears to have been also slightly misunderstood by Kutzing and Smith. The real form of the frustule is not a spheroid, as they must have considered it, but rather like that of a coffee-bean, rounded at the back and hollowed out in front, the line connecting the two terminal and central nodules of each valve being the median line; this line and the central nodule are thus not marginal, as hitherto described, but exactly as in other diatoms in which such are found. An Amphora would thus chiefly differ, by the half of the valve on the one side of the median line being concave, while the other was convex; whereas, in most

genera of the group the two halves of the valve are precisely alike.

The form and structure of the frustule being established, the parts capable of affording good distinctive marks for species were next examined. All naturalists agree, that if these are taken from variable parts, they must be of less importance than if derived from those that are subject to little or no variation; and that no observation can be relied on, of a permanent kind, when taken from parts known to change their appearance rapidly. Thus, the zone connecting the two valves of a diatom, which, from being a mere line, is understood to attain the whole breadth of the frustule in the course of twenty-four hours, has been deservedly rejected; and hence it is to be feared that few or none of Dr Gregory's species of "Complex Amphoræ," which owe their peculiar appearance to it, will stand the test of diagnostic characters. As the striæ, costæ, or furrows, are the same on both sides of the median line, and as the valve is folded, those at the back of the frustule must be seen through the medium of the surface nearer the eye, and crossing those belonging to it, so that observations on these relate entirely to the *accidental* position the frustule happens to be in. This compels one to depend chiefly for essential characters—1st, on the small portion that is seen between the median line and the apparent outline of the frustule; and 2d, on the form of the frustule itself, *previous* to the siliceous connecting zone commencing the process of self-division.

The author also stated his conviction that no certain conclusions could be drawn as to what was a new form or species from deposits or dredgings, on account of the impossibility of procuring the species in an isolated state, and consequently of studying them independently; the same species putting on very different aspects, and different species assuming the same aspect at particular stages of self-division.

Microscopical differences are by themselves of little importance. To see is one thing, to understand and combine what we see, another: the eye must be subservient to the mind. Every supposed new species requires to be separated from its allies, and then subjected to a series of careful observations and critical comparisons. To indicate *many apparently* new species is the work of an hour, to *establish* only *one* on a sure foundation is sometimes the labour of months or years. In microscopical natural history as much scrutiny is required to prove a new form to be distinct from its allies as in chemistry

to discover a new alkaloid, or in astronomy to demonstrate the identity of two comets. A naturalist cannot be too cautious. It is better to allow diatoms to remain in the depths of the sea, or in their native pools, than, *from imperfect materials*, to elevate them to the rank of distinct species, and encumber our catalogue with a load of new names so ill defined, if defined at all, that others are unable to recognise them; the same object can be more easily attained by attaching them, in the mean time, to some already recorded species, with the specific character of which they sufficiently accord. In all such cases the question to be solved for the advantage of naturalists is not, whether the object noticed be a new species, but whether it has been proved such, and clearly characterized.

The following Candidates were duly elected Fellows of the Society:—

James Leslie, Esq., C.E.
Cosmo Innes, Esq., Advocate.
Professor A. C. Fraser.

The following Donations to the Library were announced:—

Proceedings of the Royal Society, London. Vol. IX., No. 28. London. 8vo.—*From the Society.*

Proceedings and Papers of the Historic Society of Lancashire and Cheshire. Sessions 1 to 6. Liverpool, 1849–54. 8vo.—*From the Society.*

Papers read at the Royal Institute of British Architects. Sessions 1855–56 and 1856–57. London, 1856–7. 4to.

The Canadian Journal of Industry, Science, and Art. November 1857. Toronto. 8vo.—*From the Institute.*

Atlantis: A Register of Literature and Science. Conducted by Members of the Catholic University of Ireland. No. 1. January, 1858. London. 8vo.—*From the Editors.*

Œuvres Complètes de N. H. Abel, Mathématicien, avec des notes et développements. Rédigées par B. Holmboe. 2 Tomes. Christiania, 1839. 4to.—*From the University, Christiania.*

Quelques Observations de Morphologie Végétale faites au Jardin Botanique de Christiania, par J. M. Norman. Christiania, 1857. 4to.—*From M. Norman.*

Inversos vessicæ urinariæ og luxationes femorum congenitæ hos

samme Individ, iagttagne af Lektor Voss. Christiania, 1857. 4to.—*From the University, Christiania.*

Observations sur les Phénomènes d'Erosion en Norvège, recueillies par J. C. Hörbye. Christiania, 1857. 4to.—*From the University, Christiania.*

Bemerkungen über den mechanischen Bau der Baumwoll-Faser, von Gilbert J. French. Hanover, 1857. 8vo.—*From G. Lawson, Ph. D.*

Journal of the Asiatic Society of Bengal, 1857, No. 4. Calcutta, 1857. 8vo.—*From the Society.*

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, 1856, No. 4; 1857, No. 1. Wien. 8vo.—*From the Vienna Institute.*

Nyt Magazin for Naturvidenskaberne Binds I.—IX. Christiania, 1842. 8vo.—*From the University, Christiania.*

Astronomical Observations made at the Observatory of Cambridge, by the Rev. James Challis. Vol. XVIII., for the years 1849, 1850, and 1851. Cambridge, 1857. 4to.—*From the Syndicate of the Cambridge Observatory.*

Bulletin de la Société Vaudoise des Sciences Naturelles. Nos. 34–40. Lausanne, 1854–7. 8vo.—*From the Society.*

Address of Thomas Bell, F.L.S., President to the Linnean Society, London, May 25, 1857. London, 1857. 8vo.—*From the Society.*

Ueber die Geologie des Südlichen Norwegens von Theodor Kjerulf, mit Beiträgen von Tellef Dahll. Christiania, 1857. 8vo.

Lehrbuch der Mechanik von Dr P. J. Broch. Christiania, 1854. 8vo.

Beitrage zur Lateinsischen Grammatik, I. Von L. C. M. Aubert. Christiania, 1856. 8vo.

Monday, 15*th February* 1858.

MR JAMES T. GIBSON-CRAIG, Treasurer, in the Chair.

The following Communications were read:—

1. Description of the Sulphur Mine near Conil; preceded by a Notice of the Geological features of the southern portion of Andalucia. By Dr Traill.

Dr Traill's paper was divided into four sections: the 1st con-

tained the geology of Andalucia from the Sierra Nevada of Granada to the south; the 2d described the mountain or rock of Gibraltar; the 3d traced the succession of rocks from the Sierra Morena to the south and south-west; and the 4th described the Sulphur Mine near Conil.

1. In the part of the Sierra Nevada visited by Dr Traill, which was at about two-thirds of its height, the only visible rocks were mica-slate, in its lower portions approaching to gneiss, on which reposed beds of limestone, evidently belonging to the same formation as the slate. These rocks, too, form the mountain ranges south of Granada, towards the shores of the Mediterranean, near Velez-Malaga, where they are covered by a very shining clay-slate without organic remains; and which, in the Sierras Mijas and Bermeja, often contain beds of white statuary marble.

The clay-slate continues along the coast to the south of Malaga and Marbella; but at the Rio Verde it gives place to Old Red Sandstone, or *Devonian* strata; while the rugged mountains to the west appear to consist of primary rocks. This *Devonian* sandstone is the fundamental rock of the Sierra Carbonera, the nearest range to Gibraltar, and around the bay of that fortress. On this appears to repose a limestone, which the author referred to the mountain limestone. On going westwards from Granada by Loja, Archidona, and Antequera, the mountains seem to consist of limestone like that of the Sierra Nevada. But on reaching the valley of Teba, he found newer rocks, viz., a limestone containing shells, on which reposed beds of gypsum and a reddish clay. In this valley is a salt lake, evaporated for culinary salt; and the gypsum often contained crystals of rhomb-spar. This valley he therefore considered as belonging to the Magnesian Limestone and New Red formations, or *Permian* system of Sir Roderick Murchison. Farther to the south, as about Ronda and Guarroman, a gritty limestone occurs in which he found ostracites and other marine shells; and in the valley of Alhama, in Granada, similar limestone occurs, with those shells, mytilites and corals. Both formations he refers to the *Oolite* system.

2. The author described the geology of Gibraltar, which he referred entirely to the true mountain limestone, and illustrated his remarks by specimens of the solid rock, of the fibrous limestone, and of the calc-sinter deposits containing bones.

3. The author then traced the different rock formations from the Sierra Morena to the south and south-west.

In this Sierra he found in the upper regions gray and red granite, the latter often containing crystals of andalucite; and syenite also occurs in some places. These rocks are generally covered by a very shining mica-slate; but in descending towards the south, this is succeeded by clay-slate. At Sta. Elena this slate contains many crystals of chiastolite, exactly like that of Cumberland. A little south of Sta. Elena he found true grauwacke and grauwacke slate, or unmistakeable *Silurian* formations; on which reposed oolitic limestone, containing ostracites, and other shells.

The Oolite occurs in other parts of Andalucia, as already noticed; and it forms extensive tracks between Tarifa and Conil.

Still newer formations begin in the valley of the Guadalquivir, and in the country between Sevilla and Xeres. At Lebrija are hills of indurated chalk, containing flint. Tertiary formations occur between Cadiz and Gibraltar, as well as in other valleys of this province; so that Andalucia presents formations belonging to all the great geological epochs.

4. The Sulphur Mine lies near the sea, about three miles east of Conil. It occupies a small oval valley surrounded by oolitic rocks, and is filled with a bluish marl, the matrix of the sulphur. The sulphur is often finely crystallized in its cavities, and is accompanied by crystals of sulphate of lime and calc-spar. The mine was wrought until about the time of the French invasion of Spain. In 1814 it was not wrought; but this seemed less from exhaustion of the sulphur, than from the troubles of the Peninsula, and the want of fuel to sublime the sulphur. Magnificent crystals of this sulphur are in the royal cabinet at Madrid.

The author concluded by some speculations on the origin of the sulphur in the Mine of Conil.

2. Remarks on a Slab of Sandstone containing numerous Cavities, apparently produced by Marine Animals. By Charles Maclaren, Esq.

This slab was found lying on the sand about 150 yards within high-water mark, a little northward of the projecting headland called Whitberry Point, on the coast of East Lothian. The head-

land is of trap, which rests on a red sandstone, similar to that of the slab. The sandstone covers some acres northward of the headland at low water, running out in a succession of ridges in a north-east direction, and dipping to the south-east. The slab is of a triangular form; its length is 17 inches, greatest breadth 9, and the thickness varies from $1\frac{1}{2}$ to 2 inches. It rested on the sand, with the honeycombed face undermost, without any other fragments near it, and 20 yards, or more, from the nearest sandstone *in situ*. On one side it is dimpled with twenty-three round cavities, all cup-shaped. A few are so faint as to present merely slight markings; the others are from 1 inch to $1\frac{1}{2}$ inch in diameter, and from $\frac{1}{8}$ to $\frac{1}{2}$ an inch in depth, with rounded edges. The cavities shew a tendency to a linear arrangement; those in one line having their sides in contact, or nearly so; and the whole are in two groups, the cavities in each crowded together, and no one cavity standing entirely detached. The opposite side of the slab has no cavities, and is thinly covered with some species of vegetation, apparently a lichen; but there are four or five small vestiges of cavities, and two large ones on the edge of the slab. In explanation of the cavities, it was stated that there are many marine animals which bore holes in stones to make lodgments for themselves, such as those described in Forbes and Hanley's "British Mollusca," and in Doctor Johnston's "Conchology," under the titles of Pholas, Saxicava, Petricola; and in the English Cyclopædia, under that of "Lithophagidæ," including also the Patella and Echinus. These animals burrow in wood, chalk, limestones, shale, and some of them in red sandstone. Reference was also made to Dr Johnston's work (Letter 10th) to show that the property of burrowing in stone had been attributed to some terrestrial mollusks (the "Helix nemoralis," and "Helix aspersa"), by Dr Buckland, and others, though not on very certain grounds. Allusion was also made to the mode in which the Helixes named "cluster together" on the under surface of stones or ledges of rock, as presenting an analogy with the clustered or grouped disposition of the cavities, on what appears to be the "lower surface" of the slab, as indicated by the absence there of the vegetation seen on the opposite surface. The slab had evidently been moved from its original site, probably by the action of the waves in a storm. He inclined to the opinion, that the cavities were made by animals like the Patella, which bore holes to a moderate depth, and being perhaps

gregarious in their habits. Four opinions had been proposed as to the process by which the mollusks excavate the holes, and are discussed by Forbes and Hanley:—1. By rasping the rock with the sharp edge of the shell; 2. By dissolving the rock with an acid secreted by the animal; 3. By grinding with silicious particles attached to some part of its body; 4. By vibratory cilia set in motion by the animal, and producing currents of water. But objections have been made to all these opinions.

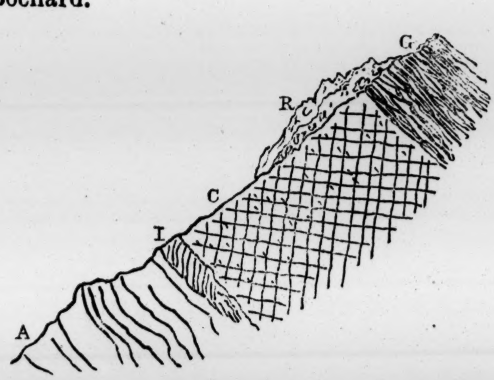
3. Notice respecting some Artificial Sections illustrating the Geology of Chamouni. By John Ruskin, Esq. Communicated in a letter to Professor Forbes.

In the Proceedings of the Royal Society, vol. iii., p. 348, an account has been given by Professor Forbes of the discussions which had then taken place as to the geological constitution of the chain of Mont Blanc, and as to the reality of the alleged superposition of the primary rock (gneiss) to the secondary (limestone), near Chamouni, and at Courmayeur.

In order to clear up any remaining doubt, Mr Ruskin caused sections to be made, laying bare the junction at several points of the Valley of Chamouni. The results, which are perfectly accordant with the conclusions of the above-cited paper, have been kindly communicated by Mr Ruskin to Professor Forbes, and are described and sketched by him in the following note. The order of the sections is from the head of the Valley of Chamouni towards its lower or south-western extremity.

Specimens of the more important rocks have been placed in the Museum of the Royal Society:—

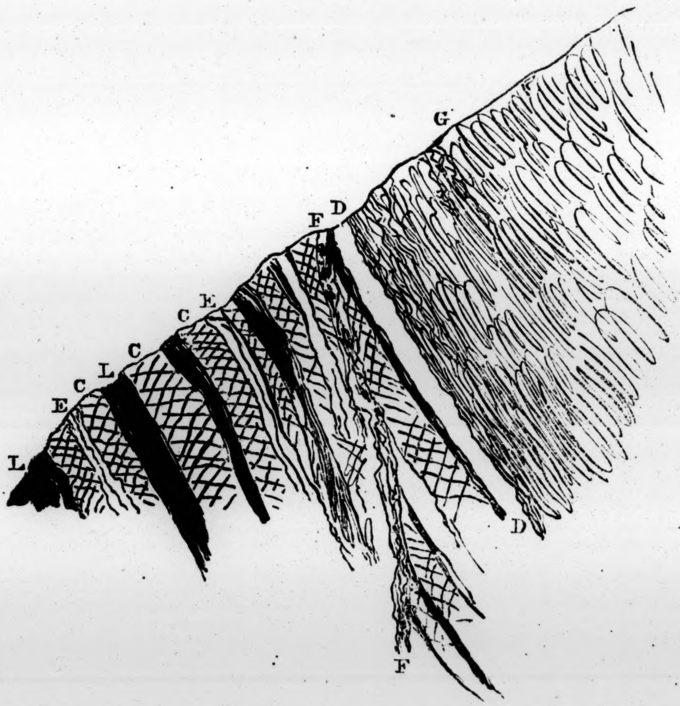
"1. At Crozzet de Lavanchi, on road to Argentiere, under the Aiguille de Bochard.



" A. Black calcareous rocks of the Buet, with belemnites, a good deal contorted (the same rock as at Côte des Pigets).
" I. Imperfect cargneule (porous limestone), about 2 feet thick.
" C. Common cargneule, used for limeworks, &c. (about 50 feet thick at the utmost).
" R. Debris concealing junction with gneiss.
" G. Gneiss laid bare, striking N. 50 E., and dipping 36° S.E., an unusually small angle, quite accidental and local, the average dip south being much steeper.

" 2. On the road to Chapeau, the same succession of beds takes place, the dip being greater (about 50°); the Buet limestones lower down dipping still more (about 65°). I say 'about,' not as guessing the angle, but giving the average of many accurate measurements.

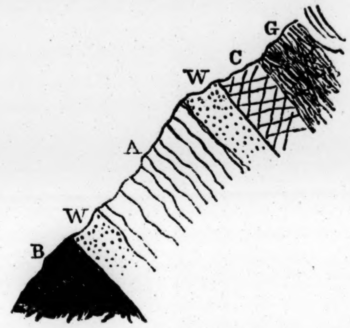
" 3. Junction opposite Prieuré of Chamouni, at my excavation.



" L. Brown limestone, a form of the cargneule.
" C. Cargneule, generally enclosing fragments of the browner limestone, and with bands of greasy green earth, E, E, in the middle of its beds.
" F. Fault filled with fragments of clay and cargneule.
" D. Decomposing white gneiss.
" G. Hard gray gneiss of Montanvert.

" 4. At Les Ouches, in the ravine under the Aiguille du Gouté.

" B. Black slates of the Buet.
" W. Pure white fine-grained gypsum.
" A. Buet limestone (A of first section).
" W. Gypsum.
" C. Cargneule (C of first section).
" G. Gneiss.



Monday, 1st March 1858.

PROFESSOR KELLAND, V.P., in the Chair.

Professor Kelland, V.P., delivered the Keith Medal, awarded by the Council to Professor Boole of Cork; on doing which he said:—

The Council of the Royal Society, in the exercise of the power conferred on them, have awarded the Keith Medal to Professor Boole of Cork, for his Memoir " On the Application of the Theory of Probabilities to the Question of the Combination of Judgments or Testimonies," printed in the Society's Transactions of last Session.

In conferring this medal, in the name of the Council, it may reasonably be expected that I should say a few words on each of two different heads—*first*, the person on whom the medal is conferred; *secondly*, the paper, which has appeared to the Council worthy of the award. And I admit that I ought not to decline to fulfil the expectation after some sort. I shall accordingly offer some remarks on these separate topics.

1. Mr Boole is a stranger to us; in no way connected with Scotland, further than as a similarity of pursuits connects one intellect with another. To Bishop Terrot alone amongst us, who is labouring successfully in the same department of science with himself, is he, so far as I am aware, personally known. I will therefore endeavour to sketch Mr Boole's past history, that you may have the

materials for inferring the amount of confidence to be placed in the researches which we have selected for honour.

Mr Boole is one of those remarkable men who, under almost every possible disadvantage, rises from obscurity to high eminence. In early youth he held the situation of usher in a school in Yorkshire. After four or five years thus spent, he commenced business as a schoolmaster, on his own account, in the city of Lincoln, being even then under twenty. He was not unsuccessful. This is a remarkable fact, when we consider that he delighted in such reading as the "*Mècanique Céleste*," and "*Liouville's & Crelle's Journals.*" That such was his reading is abundantly proved by his earlier papers—the first of which appeared, so far as I know, in the "Cambridge Mathematical Journal for 1840." These papers attracted the attention of the editor of the Journal, Mr Gregory, and a correspondence had commenced between them, which the lamented death of the latter alone prevented being productive of much valuable fruit. My first knowledge of Mr Boole, except such as might be derived from the papers above referred to, commenced in 1844, about the beginning of which year he sent to the Royal Society of London a Memoir "On a General Method in Analysis." Many problems of no very great apparent complication had baffled the ingenuity of mathematicians. Solutions were, it is true, obtained, but the processes were so indirect and unsatisfactory, that they were something like excrescences on the smooth face of science. Of this class of problems is an equation which occurs in the theory of the figure of the earth. Mr Airy, in his "Tracts," gives simply the result, without the slightest indication of a process. Mr Gaskin and Mr Leslie Ellis had attacked this individual problem with partial success. But Mr Boole's "New Method" not only set the logical question of dealing with separation of symbols in a clear light, but completely effected the solution of all that class of problems, of which this was a particular example. The Royal Society did me the honour to refer the paper to me, and I had the good fortune at once to perceive its importance, and to recommend the Society to bestow on it a mark of approbation. Accordingly, the Council of the Society awarded to Mr Boole the Royal Medal for 1844, expressing their conviction that "his Method would find a permanent place in the science."

After this he remained many years in comparative obscurity in Lincoln, but at length received the appointment of Professor of Mathe-

matics in Queen's College Cork, which he still holds. He commenced his career as professor somewhat daringly, by publishing in succession,—1*st*, "A Lecture on the Claims of Science," in which he advances out of his subject into the domain of mental philosophy. 2*d*, "An Investigation of the Laws of Thought." This last volume, which is equally remarkable for clearness of enunciation, breadth of generalization, and originality, of thought, is the prelude to the paper for which we this day present Mr Boole with the Keith Medal. Mr Leslie Ellis has pointed out in the first volume of the collected works of Bacon, that some of the germs of Mr Boole's ideas are to be found in the writings of that great philosopher, and in those of Leibnitz. But this, instead of detracting from the claims of Mr Boole, is rather a proof of his power, or at any rate of his sagacity in seizing on and developing ideas which lay unexpanded in the records of minds so vast and so original.

This is all I shall say about the *person* on whom the Keith Medal is to be conferred.

2. Let me now very briefly refer to the *paper* for which this award has been made. The problems which the author proposes to solve are these :—1*st*, That of combining testimonies whose different values may be regarded as numerical measures of a physical magnitude. 2*d*, The same problem in which the testimonies are not only expressible, as in the former, but relate to some fact or hypothesis of which it is sought to determine the probability. Relative to the former of these, an important element, now, I believe, first completely discussed, is the determination of the "Conditions of Possible Experience." Suppose, for example, it were asserted that of all cases of a certain disease, two-fifths of the patients were affected with shivering and sweating, two-thirds with shivering and thirst, and four-fifths with sweating and thirst, this very assertion would be found to contain within itself the elements of its own condemnation, seeing that it violates the conditions of possibility.

The other problem has for its object, to combine the force of two testimonies in support of a fact, the strength of each separate testimony being given. That a complete discussion of this problem is most valuable in itself cannot be doubted. What has here been written may rather be regarded as material for a future judgment than as exhausting the consideration of the question. There are so many conditions to be taken into account, and such a tendency

exists in writers to adopt one general standard of reference, that a critical examination like the present, which certainly does much towards throwing down the buildings of others, cannot fail to have great value, even should its own foundations not stand. This is not like a discovery in pure analysis,—the opening up of a royal road from one position to another,—so much as a survey of the ground, with a view to the assertion that the right road lies on this side, and not on that, of some given obstacle. In the name of the Council, I beg our Vice-President, Bishop Terrot, to take charge of this Medal for Professor Boole, and to express to him our wishes for his future success in the career to which he has devoted himself. Bishop Terrot is not, in this instance, a mere passive spectator, nor a mere hand to convey a reward from one party to another; he stands in the light of a participator in the honour, and that to no small extent. The problem of combining two or more probabilities of the same event received from Bishop Terrot a solution in our Transactions two years since, to which the present paper is probably due. Here, for the first time, was given the form of the probability or value of expectation due to *entire ignorance*, as an indeterminate fraction. This result, as indeed the other conclusions of Bishop Terrot, the present paper satisfactorily confirms. Bishop Terrot, therefore, whilst I doubt not he will cheerfully transfer the award to Mr Boole, will still retain a share in the honour.

The following Communications were then read:—

1. On the Average Value of Human Testimony. By Bishop Terrot.

The author began by some remarks upon the expression $\frac{pv}{pv+(1-p).(1-v)}$ or $\frac{pv}{pv+wq}=\text{U}$. Where p represents the *a priori* probability of an event attested by a witness whose veracity, or the ratio of whose true assertions to the number of all his assertions is, v. He observed that U, or the ultimate probability of the asserted fact, depended upon the accuracy of the numerical value given to v, and that men have never such knowledge of their neighbours' antecedents, as to assume this value with anything like an approximation to the truth.

It was then suggested that a more definite result might be

obtained, by assuming, from experience, the value of U, and thence determining the value of v. The instance adopted was that of a man saying that out of a bag containing 99 white balls and one black, he has at the first trial drawn the black. In such a case, so long as there exists in our minds no suspicion of a motive for falsehood, the assertion is absolutely believed; that is to say, we give to U the value unity. But p being the proper fraction $\frac{1}{100}$, U cannot equal 1 unless $v=1$; that is to say, unless we consider human testimony, even to improbable events, as certainly truthful, in every case where there exists no suspicion of the action of a motive for falsehood. The suspicion of such motive at once prevents us from giving to U the value 1; that is, from receiving the assertion as absolutely true. If, for example, the man who drew the black ball was to gain L.1000 by our being persuaded that he had done so, we should not readily take his word for the fact that he had so succeeded.

It was then noticed that the expression for the ultimate probability given by Laplace was

$$\frac{vr+(1-v).(1-r)}{vr+(1-v).(1-r)+\left[v.(1-r)\times r(1-v)\right]\frac{1-p}{p}},$$

where r represents the probability that the witness, though intending to tell the truth, deceives himself. If in this expression 1 be substituted for (r) this formula coincides with $\frac{pv}{pv+(1-p).1-v}$, for all the cases treated in the paper are cases where there can be no reasonable suspicion that the witness is deceived. It was at the same time allowed that there are numerous cases where a suspicion of this, or some other disturbing force, may reasonably be suspected. But it was maintained that such cases, however numerous, are *exceptional*, and are very few compared with those to which no suspicion attaches: and that were this not the case, human testimony would be of no practical value, and human society could not subsist. The final inference was, that habitual credulity is less unreasonable than habitual incredulity; that in the former the exception is sacrificed to the rule, in the latter the rule is sacrificed to the exception.

2. On the Tides in the Sound of Harris. By Henry C. Otter, Esq., R.N., Captain H.M.S. "Porcupine." Communicated by Dr Stark.

The author stated that during summer, in neap tides, the stream flows from the Atlantic into the Minch all day, but from the Minch into the Atlantic all night. In winter this was reversed, the stream flowing through the Sound of Harris from the Minch into the Atlantic all day, but from the Atlantic into the Minch all night.

In spring tides, both during summer and winter, the stream comes in from the Atlantic during the greater part of the time the water is rising, and flows back into the Atlantic during the greater portion of the fall of the tide.

The rise and fall of the tide was found to be much more influenced by the direction and force of the wind than by the moon's parallax. Thus, a strong southerly or south-west wind raised the water to equinoctial height, but produced a very poor ebb. The velocity of the current through the Sound of Harris was stated to be about five miles an hour during spring tides, but only from two to two and a-half miles an hour during neap tides.

Various other interesting particulars were mentioned relative to the local peculiarities of the tides in the "Narrows of Berneray," at the "Hermetray Group," and at the "Groay Group," and a diagram was exhibited, by means of which the time of high water and low water could be easily found in the Sound of Harris, on knowing the moon's meridian passage.

Dr Stark, who communicated the paper, appended a note, endeavouring to account for the peculiarity in the current through the Sound of Harris, attributing it to a difference in the level of the water in the Atlantic and the Minch, caused by the attraction of the sun. So long as the sun was north of the equator, and its attractive power was greatest over the North Atlantic, the level of the Atlantic during the day would probably be found to be higher than that of the water in the Minch, so that during all the day the current would run from the Atlantic into the Minch; during night, when the attractive power of the sun was removed from the North Atlantic, its level would fall, so that the stream would flow from the Minch into the Atlantic. In *winter*, when the sun was south of the equator, its

attractive power being exerted during the day on the South Atlantic, the level of the North Atlantic would be lowered; so that, *during the day*, the stream would flow from the Minch into the Atlantic. *During the night*, from the removal of the sun's attraction over the South Atlantic, the North Atlantic would regain its level; so that during the night, in winter, the stream would flow from the Atlantic into the Minch.

The following Donations to the Library were announced:—

Quarterly Return of the Births, Deaths, and Marriages registered in the Divisions, Counties, and Districts of Scotland. Quarter ending 31st December 1857.—*From the Registrar-General.*

Journal of Agriculture and Transactions of the Highland and Agricultural Society of Scotland. March 1858.—*From the Society.*

Documents and Proceedings connected with the Donation of a Free Public Library and Museum by William Brown, M.P., to the Town of Liverpool. Liverpool, 1858. 8vo.—*From Dr Hume.*

Philosophical Transactions of the Royal Society of London for the year 1857. Vol. CLXVII., Part II. London. 1858. 4to. —*From the Royal Society of London.*

List of the Royal Society of London, 1857.—*From the Society.*

Six Discourses delivered before the Royal Society, &c. By Sir Humphrey Davy, Bart. London. 1827. 4to.—*From the Society.*

Report on the Adjudication of the Copley, Rumford, and Royal Medals, &c. London. 1834. 4to.—*From the Royal Society of London.*

Portugaliæ Monumenta Historica, a sæculo octavo post Christum usque ad quintumdecimum, jussu Academiæ Scientiarum Olisiponensis edita. Leges et Consuetudines, volumen I. fasc. 1. Scriptores, volumen I. fasc. 1. Olisipone. 1856.—*From the Royal Academy, Lisbon.*

Memorias da Academia R. das Sciencias de Lisboa, 2ª serie, tom. I, II, III. Do. Nova serie 1ª e 2ª classe, tom. I., pt 1 e 2; 2 pt 2.—*From the same Academy.*

The Canadian Journal of Industry, Science, and Art. January 1858.—*From the Canadian Institute.*

Almanaque Nautico para el ano 1859. Calculado de Órden de S. M. en el Observatorio de Marina de la Ciudad de S. Fernando. Cadiz. 1857.—*From the Observatory, St Fernando.*

Sulle forme cristalline del Boro Adamantino, per Quintino Seila. Torina. 1857. 4to.—*From the Author.*

Sulle forme cristalline di Alcuni sali de Platino e del Boro Adamantino, per Quintino Sella. Torino. 1857. 4to.—*From the Author.*

Translation from Dutch Pamphlets on Herring Fisheries. 1857. (Board of Trade). London. 1858. 8vo.—*From Dr Stark.*

Proceedings of the Royal Astronomical Society. Vol. XVIII. No. 3.—*From the Society.*

Quarterly Journal of the Chemical Society. No. 40.—*From the Society.*

Collecçào de Noticias para a Historia e Geografia das Naçòes Ultramarinas, que vivem nos dominios Portuguezes ou Lhes São Visihhas; publicada pela Academia Real das Sciencias. Tom. V., VI., VII. Lisboa. 1836–56. 8vo.—*From the Royal Academy of Lisbon.*

Viagens extensas e dilatadas do celebre Arabe Abu-Abdallah, mais conhecido pelo nome de Ben-Batuta. Traduzidas por Jose de Santo Antonio Moura. Tomo II. Lisboa. 1855. 8vo.—*From the same Academy.*

Annales das Sciencias e Lettras, publicados debaixo dos auspicios da Academia Real das Sciencias. 1ª Classe, Sciencias, Mathematicas, Physicas, Historico-Naturaes, e Medicas, tomo I. Marco–Septembro, 1857. 2ª Classe, Sciencias, Moraes, e Politicas, e Bellas Lettras, tome I. Marco–Julho, 1857.—*From the same Academy.*

Transactions of the Linnean Society of London. Vol. XXII., Part 2. London. 1857. 4to.—*From the Society.*

Monday, 15*th March* 1858.

THE RIGHT REV. BISHOP TERROT, V.P., in the Chair.

The following Communications were read:—

1. Note on the use of Subacetate of Lead as a means of separating some of the Vegetable Alkaloids. By Thomas Anderson, M.D., F.R.S.E.

In a paper on the crystalline constituents of opium, read before the Royal Society of Edinburgh, I described a process for separating thebaine from papaverine and narcotine, with which it occurs mixed in the opium liquor I examined. This process consisted in converting the mixed bases into acetates, and adding to the solution an excess of subacetate of lead, by which the feebler bases are precipitated, and the stronger thebaine left in solution.

As it is familiarly known that in those plants in which alkaloids are found, they rarely occur singly, but are generally associated in groups of two or more, often very closely allied in their properties, and consequently require for their separation, processes of considerable complexity, I have been induced to make a few experiments, with the view of ascertaining whether the method I had applied with success to the opium bases could be used for other substances. These observations I offer, not as exhausting the subject, but merely as an indication of a path which may be followed by those engaged in the examination of the natural bases with some prospect of success.

When a dilute solution of acetate of strychnine, containing an excess of acid, is mixed with a saturated solution of subacetate of lead, until its reaction becomes alkaline, and a further quantity of the lead-salt added, the fluid at first remains perfectly clear; but after some time minute crystals of strychnine begin to be deposited, and go on gradually increasing in quantity for four-and-twenty hours. If the solution be highly diluted, the strychnine is deposited slowly, and then appears in very regular crystals, occasionally of considerable size. Concentrated solutions, if violently agitated, are rapidly filled with precipitated strychnine.

If brucine be treated in a similar manner, the solution remains

perfectly clear, and, even where violently agitated, no precipitate makes its appearance. At the end of twenty-four hours, the fluid is still clear, although I have once or twice, when the solution was concentrated, observed a few needle-shaped crystals of the base at the bottom of the fluid.

Acetate of cinchonine, in moderately diluted solution, begins to deposit small crystals of the base almost immediately after the subacetate is added, and the quantity goes on increasing for some hours. Agitation produces an immediate precipitate.

Quinine is not deposited from its acetate, even on standing during the night, provided the solution be dilute; but if concentrated and briskly shaken, small tufts are occasionally thrown down after standing for some hours.

Morphine and thebaine are not thrown down from solutions of their acetates, even after standing; and codeine, as might be anticipated from its solubility in water, is entirely unaffected. On the other hand, narcotine, papaverine, and narcine are instantaneously precipitated as bulky powders.

These facts indicate the importance of a more minute attention being paid to the deportment of the vegetable alkaloids with subacetate of lead. We observe that in the case of the two cinchona and the two nux vomica alkaloids, the difference is very marked, and the reaction might be used as a means of separation, and possibly also of purification. Most of the substances found in vegetable extracts, such as gum, &c., are precipitated by subacetate of lead; and in the case of the stronger bases, it might be possible to effect purification by extracting with acetic acid, and precipitating with the subacetate. The strong base would then remain in solution along with excess of lead, which being precipitated with sulphuretted hydrogen, would carry down colouring matters, and leave a pure acetate in solution. I have not attempted to put this process into practice, but recommend a trial of it to those chemists who are engaged with the examination of the natural alkaloids.

2. On the Colouring Matter of Persian Berries. By Mr John Gellatly, assistant to Dr Anderson, Glasgow.

Two varieties of the seeds of the *Rhamnus tinctoria* are found in commerce, known by the names of Persian and Turkish berries. The

former are said to be gathered before being fully ripe, and are carefully preserved; the latter have remained much longer on the branches, and are brown and shrivelled. Kane has examined both varieties, and finds in the former a substance which he names Chrysorhamnine, soluble in alcohol and ether, and crystallizing from the latter in minute silky needles of a brilliant yellow colour. This substance is replaced in the ripe berry by another, which he names Xanthorhamnine, of a much less beautiful yellow, and not crystallizable; this change is effected also by boiling the chrysorhamnine for a few minutes with water. Xanthorhamnine is easily soluble in alcohol and water, but quite insoluble in ether.

The Persian berries which the author examined yielded to ether no chrysorhamnine, but with alcohol they gave a considerable quantity of a pale yellow substance in fine crystals, which was believed to be Kane's xanthorhamnine, although that chemist did not obtain it crystalline.

It is prepared by digesting the coarsely-ground berries for a short time with boiling methylated spirit, filtering and expressing the residue. The fluid is left for several days, to deposit a dark-coloured resin, and then poured off and set aside. In about ten days, it is converted into a yellow semi-solid mass. This is pressed and recrystallized several times from alcohol; when nearly pure, the crystals appear as the solution cools.

Xanthorhamnine appears in tufts of dense silky needles, of a pale yellow colour, and nearly tasteless. Readily soluble in cold and warm water. It dissolves also in alcohol, and very readily when hot. It is quite insoluble even in boiling ether. The analysis of three separate preparations, dried at 212°, gave results somewhat different from Kane's; and, guided by the products of decomposition detailed in the paper, the author proposes for the substance the formula $C_{46}\,H_{28}\,O_{28}$, which agrees with his experiments, as shown by the subjoined comparison—

Carbon	52·43	52·24	51·82	51·91	52·27	C_{46}	276
Hydrogen	5·85	5·58	5·74	5·95	5·30	H_{28}	28
Oxygen	...	...	...	...	42·43	O_{28}	224
					100·00		528

The air-dried substance contains 10 atoms more water, giving the formula $C_{46}\,H_{28}\,O_{28}$, 10 HO.

A compound, prepared by adding neutral acetate of lead to an alcoholic solution of the colouring matter, keeping the latter in excess, approaches the formula $C_{46} H_{28} O_{28}$, 2PbO, 8HO.

When xanthorhamine is boiled with weak sulphuric acid, it is resolved into grape sugar and a yellow powder, which the author proposed to name Rhamnetine; showing the colouring matter to be a glucoside. In the proportion of its constituents, its softish, nearly tasteless crystals, and insolubility in ether, it agrees with these bodies generally.

The composition of rhamnetine agreed closely with the formula $C_{22} H_{10} O_{10}$. It is almost entirely insoluble in water, alcohol, and ether; alkalies dissolve it, and acids reprecipitate it from an alkaline solution. The ammoniacal solution precipitates metallic salts.

On adding the formula of rhamnetine to that of grape sugar, we have xanthorhamnine *plus* 6 atoms of water.

$$\underset{\text{Rhamnetine.}}{C_{22} H_{10} O_{10}} + \underset{\text{Glucose.}}{C_{24} H_{24} O_{24}} = \underset{\text{Xanthorhamnine.}}{C_{46} H_{28} O_{28}} + 6HO.$$

Quantitative determinations of the rhamnetine and glucose give results agreeing with this equation.

If the formula given by Kane for chrysorhamnine be doubled, we have the formula of xanthorhamnine *minus* 6 atoms of water—

$$\underset{\text{Chrysorhamnine.}}{C_{46} H_{22} O_{22}} + 6HO = \underset{\text{Xanthorhamnine.}}{C_{46} H_{28} O_{28}}$$

3. Account of some Experiments on Radiant Heat. By B. Stewart, Esq. Communicated by Professor Forbes.

The object of these experiments was to compare together the radiations from the polished surfaces of different bodies, all having the temperature of 212°. In order to heat the bodies, a tin box was used, double-sided and double-bottomed, or a box within a box. Water being kept boiling in the interval, the interior chamber was found to have a temperature of nearly 212°; and on the bottom of this chamber the bodies to be experimented on were placed. When being used these were taken out of the chamber and placed before the sentient pile of a thermo-multiplier, the galvanometer needle connected with which was immediately deviated from its zero position. The extent of the first swing of this needle was taken to denote the quantity of heat that fell upon the pile, and this deviation

taking place in about 12 seconds after the substance had been taken out of the boiling water apparatus, it was found that during this small portion of time the substance might be supposed to keep its original temperature of 212°, its cooling being so small as to be neglected.

In order that different substances might be compared with one another, the same amount of heated surface was always presented to the pile.

In the first group of experiments, the quantities of heat radiated from polished plates of different substances (heated to 212°) were compared with the quantity radiated from a similar surface of lamp-black at the same temperature. It was found that glass, alum, selenite, and thick mica, radiated very nearly as freely as lamp-black; while the radiation from rock-salt was only 15 per cent. of that from lamp-black.

In the second group of experiments, the quantities of heat radiated at 212° from polished plates of the same substance, but of different thicknesses, were compared with one another.

It was found that thickness made a scarcely perceptible difference on the quantity of heat radiated by glass, a somewhat greater difference on the quantity radiated by mica, and a very sensible difference on the quantity radiated by rock-salt—a thick plate of this substance giving more than a thin plate, in the proportion of nearly 5 to 3.

The third group of experiments showed that heat from a polished plate of any substance is less transmissible through a screen of the same substance than heat from lamp-black; this difference being exceedingly marked in the case of rock-salt,—the same rock-salt screen which transmits $\frac{3}{4}$ths of the rays which fall upon it from heated lamp-black, transmitting only $\frac{1}{3}$d of the rays that issue from heated rock-salt.

The fourth group of experiments showed that heat from a thick plate of any substance is more transmissible through a screen of the same substance than heat from a thin plate.

These four groups of experiments show that the radiation from diathermanous bodies, such as rock-salt, is much less copious than that from bodies of an opposite nature, such as glass; and also that the radiation from diathermanous bodies increases with the thickness of the plate.

It was shown that all these results follow from Prevost's theory of exchanges. For if we suppose a plate of rock-salt placed in a chamber of lamp-black, all at 212°, then, since the temperature of the rock-salt remains the same, it must radiate as much as it absorbs. But since it absorbs but a small proportion of the lamp-black heat, it will radiate but a small proportion, and since a thick plate of rock-salt would absorb more than a thin plate, it would also radiate more.

The radiation of such a thin plate is therefore equal to its absorption.

It was then shown that for every separate ray of which the heterogeneous radiation of 212° is composed this equality must hold; and that for every such ray the absorption of such a thin plate = its radiation.

It was shown that the reason why rock-salt is opaque to heat from rock-salt is this. There are a few rays out of the total lamp-black radiation of 212° for which rock-salt is opaque; these rays, therefore, are rapidly absorbed by a thin plate of rock-salt; but the radiation being equal to the absorption for every kind of heat, this thin plate will chiefly radiate such rays, which will consequently be stopped by a screen of rock-salt.

In conclusion, it was shown that if we have a chamber, whose walls are composed of different substances, kept at a uniform temperature, the heat radiated and reflected together from any given portion of the surface of its wall will be independent of the nature of the substance of which that surface is composed; the only difference being, that in the case of a metal, it will be chiefly reflected and little radiated heat, while in the case of lamp-black it will be altogether radiated heat. But for all substances, radiated + reflected heat = a constant quantity.

The following Gentleman was elected an Ordinary Fellow:—

The Rev. Dr Stevenson.

The following Gentleman was elected an Honorary Fellow:—

Professor A. D. Bache, Superintendent of the United States Coast Survey.

The following Donations to the Library were announced:—

A Treatise on Electricity in Theory and Practice. By Aug. De la Rive. Translated for the Author by Charles V. Walker, F.R.S. London, 1858. 8vo. Vol. III.—*From the Author.*

Journal of the Statistical Society, March 1858.—*From the Society.*

The American Journal of Science and Art. January 1858. 8vo. —*From the Editors.*

Transactions of the Royal Scottish Society of Arts. Vol. V. Part 1. Edinburgh, 1857, 8vo.—*From the Society.*

Memorie della Accademia delle Scienze dell' Instituto di Bologna. Tomo VII. Bologna, 1857, 4to.—*From the Academy.*

Proceedings of the Royal Astronomical Society. Vol. XVIII. No. 4.—*From the Society.*

Proceedings of the Royal Society of London. Vol. IX. No. 29.—*From the Society.*

Map of England and Wales, showing the Path of the Centre of the Moon's Shadow on the 15th March 1858.—*From H. F. Talbot, Esq.*

Monday, 5th April 1858,

THE RIGHT REV. BISHOP TERROT in the Chair.

The following Communications were read:—

1. On the Facets and Corners of Flat-Faced Solids. By Edward Sang, Esq F.R.S.E.

In this paper it was shown that the usually received theorems concerning the faces of polyhedrons are true only of one class of solids. The theorem that "*no solid can have every one of its faces more than pentagonal*" was contradicted by the exhibition of a solid bounded entirely by hexagons. Each corner of this solid is trihedral, and the sum of all its angles amounts to four times as many right angles as there are corners; whereas the usual theorem is, that "*the angles of any solid amount to four times as many right angles as there are corners, less* EIGHT." The number of uniformal solids, that is of solids of which all the faces have the same number of sides, and all the corners the same number of angles, instead of being *five*, was shown to be indefinite by the exhibition of the solid

just mentioned and of another having each face tetragonal, and each corner tetrahedral.

2. Biographical Notice of the late Professor Edward Forbes. By Prof. George Wilson.

Monday 19*th April*, 1858.

Dr CHRISTISON, V.P., in the Chair.

The following Communications were read:—

1. Notice respecting the remains of a Seal, in the Pleistocene of Fifeshire. By Dr Allman.

Professor Allman exhibited a portion of a pelvis of a seal, which had been recently obtained from the Pleistocene deposits in the neighbourhood of Kirkaldy, and sent to him for determination by Mr Martin Rigney of that place.

From a note received from Mr Rigney, it appears that the bone was found in the Tyrie clayfield, about two miles west of Kirkaldy, and about a quarter of a mile from the shore of the Firth, and that it lay 18 or 19 feet below the surface of the soil, and about 30 feet above the present level of high-water. It was unaccompanied by any other remains.

Mr Page had already noticed the occurrence of a very perfect skeleton of a seal from another locality in Fifeshire; and the great rarity of such remains in the British Isles appeared to Professor Allman a sufficient reason for placing the present instance also on record.

2. On Theories of the Constitution of Saturn's Rings. By Professor Clerk Maxwell.

The planet Saturn is surrounded by several concentric flattened rings, which appear to be quite free from any connection with each other, or with the planet, except that due to gravitation.

The exterior diameter of the whole system of rings is estimated at about 176,000 miles, the breadth from outer to inner edge of the entire system, 36,000 miles, and the thickness not more than 100 miles.

It is evident that a system of this kind, so broad and so thin, must depend for its stability upon the dynamical equilibrium between the motions of each part of the system, and the attractions which act on

it, and that the cohesion of the parts of so large a body can have no effect whatever on its motions, though it were made of the most rigid material known on earth. It is therefore necessary, in order to satisfy the demands of physical astronomy, to explain how a material system, presenting the appearance of Saturn's Rings, can be maintained in permanent motion consistently with the laws of gravitation. The principal hypotheses which present themselves are these—

I. The rings are solid bodies, regular or irregular.
II. The rings are fluid bodies, liquid or gaseous.
III. The rings are composed of loose materials.

The results of mathematical investigation applied to the first case are,—

1*st*. That a uniform ring cannot have a permanent motion.

2*d*. That it is possible, by loading one side of the ring, to produce stability of motion, but that this loading must be very great compared with the whole mass of the rest of the ring, being as 82 to 18.

3*d*. That this loading must not only be very great, but very nicely adjusted; because, if it were less than ·81, or more than ·83 of the whole, the motion would be unstable.

The mode in which such a system would be destroyed would be by the collision between the planet and the inside of the ring.

And it is evident that as no loading so enormous in comparison with the ring actually exists, we are forced to consider the rings as fluid, or at least not solid; and we find that, in the case of a fluid ring, waves would be generated, which would break it up into portions, the number of which would depend on the mass of Saturn directly, and on that of the ring universally.

It appears, therefore, that the only constitution possible for such a ring is a series of disconnected masses, which may be fluid or solid, and need not be equal. The complicated internal motions of such a ring have been investigated, and found to consist of four series of waves, which, when combined together, will reproduce any form of original disturbance with all its consequences. The motion of one of these waves was exhibited to the Society by means of a small mechanical model made by Ramage of Aberdeen.

This theory of the rings, being indicated by the mechanical theory as the only one consistent with permanent motion, is further confirmed

by recent observations on the inner obscure ring of Saturn. The limb of the planet is seen through the substance of this ring, not refracted, as it would be through a gas or fluid, but in its true position, as would be the case if the light passed through interstices between the separate particles composing the ring.

As the whole investigations are shortly to be published in a separate form, the mathematical methods employed were not laid before the Society.

3. On a peculiar Ligament connecting the opposite Ribs in certain Vertebrata. By Dr Cleland. Communicated by Professor Goodsir.

While examining the bones of a seal which had been for some time in maceration, the author observed that, in detaching one of the ribs from the vertebral column, a long ligament, connected to the head of the former, emerged from the intercostal foramen.

It was then found that the right and left rib in all the pairs articulating with two vertebræ were connected across the mesial plane by a ligament which was attached at each end to a depression on the lower part of the continuous convex cartilaginous surface of the head of the rib, and was lodged in a tube on the floor of the spinal canal, formed by a groove on the upper surface of the corresponding intervertebral disc covered by the superior longitudinal ligament, and lined by a synovial membrane common to the tube, the ligament contained in it, and the entire heads of both the ribs.

It appeared probable that this peculiar transverse intercostal ligament would be found developed in the mammalia directly as the flexibility of the spine.

In the weasel and squirrel it is fully developed; also in the lion, fox, and dog; but in the three latter the single synovial membrane common to the entire arrangement only lines the groove on the superior edge of the intervertebral disc and the under surface of the ligament, the latter being thus in contact above with the superior longitudinal ligament of the spine.

In the sheep and horse the fibres of the anterior half of the ligament are attached midway to the posterior superior margin of the body of the vertebræ in front. In the sheep there are two synovial membranes for the head of each rib,—the posterior on each side com-

municating across the mesial plane behind the ligament. In the horse there are not only two synovial membranes for the head of each rib, but an intermediate one for the ligament itself.

In the rabbit, fibres extend across from the head of one rib to that of the opposite, but are closely incorporated with the intervertebral disc.

In the kangaroo, monkey, and human subject, there is no trace of the transverse intercostal ligament.

The author is inclined to consider this transverse intercostal ligament as represented by the transverse ligament of the atlas, and both structures as morphologically related to the perforated form of the intervertebral disc.

The communication concluded with observations on the relative movements of the ribs and spine, in connection with this ligament; and on its probable functions.

4. On the Movements of the Articulation of the Lower Jaw. By Dr John Smith. Communicated by Professor Goodsir.

After alluding to the difficulty of determining the precise anatomical configuration of the condyles of the lower jaw, especially in the human subject, the temporo-maxillary articulation admitting of a multiplicity of movements, and these again being liable to modification by different accidental and other conditions of relative structures, such as the teeth, &c., the author stated that a general principle would nevertheless be found to prevail, and in general to be distinctly traceable in this joint, whatever might be the modifications existing either in its function or external form.

In man, and many of the mammalia, one essential movement of the lower jaw consists in simply opening and shutting the mouth, in a vertical plane: here the temporo-maxillary articulation is said to act as a *simple hinge*. Another essential motion is that by which grinding of substances between the molar teeth during mastication is performed: here the action of the joint has apparently been regarded as somewhat irregular and subordinate in its nature.

In the first-mentioned movement, however, the condyles cannot act as a *simple hinge*, as they lie—not at right angles to the plane of motion of the lower jaw—but obliquely to it, each condyle looking inwards and forwards. Their more perfect action, therefore, cannot

occur in this movement, but seems to belong to the second we have mentioned, viz., that of mastication.

The articulating surface, strictly speaking, on each condyle appears to constitute the thread, or rather part of the thread, of a conical screw passing over an axis lying at or about right angles to the plane of motion in simple opening and closing of the jaws. This spiral course of the articular surface is perhaps best seen in some of the larger carnivora, such as the lion, but is also obvious in a well-developed human condyle.

The action of this conical screw or tap within the glenoid cavity, considered as the conical die, takes place with accuracy only when one joint alone acts with the condyle within the glenoid cavity—the other condyle being beyond it, and gliding upon the surface of the zygoma, as during mastication. The food is in this process crushed between the molar teeth of that side whose condyle remains within the glenoid cavity; this condyle screwing the jaw back, so to speak, to its natural position at each closure of the teeth.

By this construction a great amount of friction is avoided; what would otherwise be a *rubbing* being thus converted into a *rolling* motion between the condyloid and glenoid surfaces; while by one or other condyle always remaining in the glenoid cavity during mastication greater steadiness and security is afforded to the joint.

5. On some properties of Ice near its Melting Point. By Professor Forbes.

"During the last month of March I made some experiments on the properties of ice near its melting point, with particular reference to those of Mr Faraday, published in the Athenæum and Literary Gazette for June 1850, to which attention has been more lately called by Dr Tyndall and Mr Huxley in relation to the phenomena of glaciers.

"Owing to indisposition, I have been obliged to leave my experiments for the present incomplete. But I am desirous, before the session of the Royal Society closes, to place on record some facts which I have observed, and also some conclusions which I deduce from these and other recent experiments and discussions.

"Mr Faraday's chief fact, to which the term 'regelation' has been more lately applied, is this, that pieces of ice, in a medium

above 32°, when closely applied, freeze together, and flannel adheres apparently by congelation to ice under the same circumstances.

"1. These observations I have confirmed. But I have also found that metals become frozen to ice when they are surrounded by it, or when they are otherwise prevented from transmitting heat too abundantly. Thus a pile of shillings being laid on a piece of ice in a warm room, the lowest shilling, after becoming sunk in the ice, was found firmly attached to it.

"2. Mere *contact*, without *pressure*, is sufficient to produce these effects. Two slabs of ice, having their corresponding surfaces ground tolerably flat, were suspended in an inhabited room upon a horizontal glass rod passing through two holes in the plates of ice, so that the plane of the plates was vertical. Contact of the even surfaces was obtained by means of two very weak pieces of watch-spring. In an hour and a half the cohesion was so complete, that, when violently broken in pieces, many portions of the plates (which had each a surface of 20 or more square inches) continued united. In fact, it appeared as complete as in another experiment where similar surfaces were pressed together by weights. I conclude that the effect of pressure in assisting "regelation" is principally or solely due to the larger surfaces of contact obtained by the moulding of the surfaces to one another.

"3. Masses of strong ice, which had already for a long time been floating in unfrozen water-casks, or kept for days in a thawing state, being rapidly pounded, showed a temperature 0°·3 Fahrenheit below the true freezing point, shown by delicate thermometers (both of mercury and alcohol), carefully tested by long immersion in a considerable mass of pounded ice or snow in a thawing state.

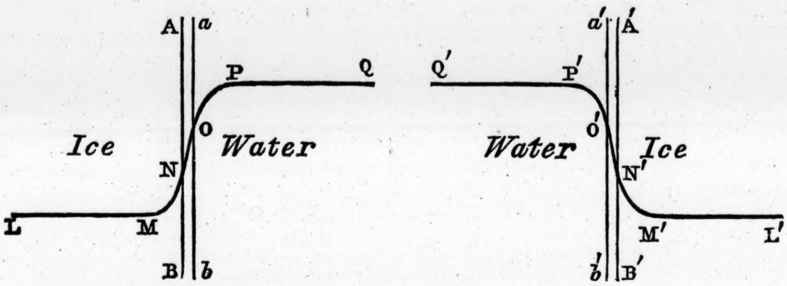
"4. Water being carefully frozen into a cylinder several inches long, with the bulb of a thermometer in its axis, and the cylinder being then gradually thawed, or allowed to lie for a considerable time in pounded ice at a thawing temperature, showed also a temperature decidedly inferior to 32°, not less, I think, than 0°·35 Fahrenheit.

"I think that the preceding results are all explicable on the one admission, that Person's view of the gradual liquefaction of ice is correct (*Comptes Rendus*, 1850, vol. xxx. p. 526),* or that ice

* Quoted by me in 1851, in my sixteenth letter on Glaciers.

gradually absorbs latent heat from a point very sensibly lower than the zero of the centigrade scale.

" I. This explains the permanent lower temperature of the interior of ice.



" Let AB be the surface of a block of ice contained in water at what is called a freezing temperature. That temperature is marked by the level of the line QP above some arbitrary zero. LM is, in like manner, the permanent but somewhat lower temperature possessed by the interior of the ice. The space, partly water, partly ice, or partaking of the nature of each, MNOP, has a temperature which varies from point to point, the portion NO corresponding to what may be called the physical surface of the ice between AB and *ab*, which is " plastic ice," or " viscid water," having the most rapid variation of local temperature.

" II. Such a state of temperature, though it is in one sense permanent, is so by compensation of effects. Bodies of different temperatures cannot continue so without interaction. The water *must* give off heat to the ice, but it spends it in an insignificant thaw at the surface, *which therefore wastes even though the water be what is called ice cold*, or having the temperature of a body of water inclosed in a cavity of ice.*

" This waste has yet to be proved; but I have little doubt of it; and it is confirmed by the wasting action of superficial streams on the ice of glaciers, though other circumstances may also contribute to this effect.

" III. The theory explains " regelation." For let a second plane surface of ice A′B′ be brought up to nearly physical contact with

" * I incline to think that water, in these circumstances, may, though surrounded by ice, have a fixed temperature somewhat higher than what is called 32°. But I have not yet had an opportunity of verifying the conjecture.

" [My idea is that the invasion of cold from the surrounding ice is spent in producing a very gradual " regelation" in the water which touches the ice, leaving the interior water in possession of its full dose of latent heat, and also

the first surface AB. There is a double film of "viscid water" isolated between two ice surfaces colder than itself. The former equilibrium is now destroyed. The films AB*ba* and A′B′*b′a′* were kept in a liquid or semi-liquid state by the heat communicated to them by the perfect water beyond. That is now removed, and the film in question has ice colder than itself on both sides. Part of the sensible heat it possesses is given to the neighbouring strata which have less heat than itself, and the intercepted film of water in the transition state becomes more or less perfect ice.

"Even if the second surface be not of ice, provided it be a bad conductor, the effect is practically the same. For the film of water is robbed of its heat on one hand by the colder ice, and the other badly-conducting surface cannot afford warmth enough to keep the water liquid.

"This effect is well seen by the instant freezing of a piece of ice to a worsted glove even when on a warm hand. But metals may act so, provided they are prevented from conveying heat by surrounding them with ice. Thus, as has been shown, metals adhere to melting ice."

Edinburgh, 19th April 1858.

The following Donations to the Library were announced:—

Monthly Return of the Births, Deaths, and Marriages, registered in the eight principal towns of Scotland, with the causes of Death, at four periods of Life, March 1858.—*From the Registrar-General.*

Supplement to the Monthly Returns of Births, Deaths, and Marriages. Year 1857.—*From the Registrar-General.*

Monatsbericht der Königlichen Preuss Akademie der Wissenschaften zu Berlin. Sept., Oct., Nov., Dec. 1857. 8vo.—*From the Berlin Academy.*

The American Journal of Science and Art. March 1858, 8vo.—*From the Editors.*

of a temperature which may slightly exceed 32°. By similar reasoning, a small body of ice, inclosed in a large mass of water, will preserve its proper internal temperature *below* 32°; but, instead of regelation taking place, the surface is being gradually thawed. This is the case contemplated in the paragraph of the text to which this note refers.]"

N.B.—*The words in brackets were added to this note during printing.* 13*th May* 1858. J. D. F.

Proceedings of the Royal Medical and Chirurgical Society of London. Vol. II., No. 1. London, 1858. 8vo.—*From the Society.*

Catalogue of the Antiquities of Stone, Earth, and Vegetable Materials in the Museum of the Royal Irish Academy. By W. R. Wilde, M.R.I.A. Dublin, 1857.—*From the Irish Academy.*

Account of the Astronomical Experiment of 1856, on the Peak of Teneriffe. By Professor C. Piazzi Smyth, Astronomer Royal for Scotland.—*From the Author.*

Monthly Notices of the Royal Astronomical Society, from November 1856 to July 1857. Vol. XVII. London, 1857. 8vo.—*From the Society.*

Memoirs of the Royal Astronomical Society. Vol. XXVI. London, 1858. 4to—*From the Society.*

Mémoire sur un rapprochement nouveau entre la Théorie moderne de la propagation linéaire du son, dans un tuyau cylindrique, horizontal d'une longuer indífinie et la Théorie des pulsions, exposée par Newton dans les deux Propositions XLVII, et XLIX du second Livre des Principes, par Jean Plana. Turin, 1857. 4to.—*From the Author.*

Mémoire sur la mouvement conique à double courbure d'un pendule simple dans le vide abstraction faite de la rotation diurne de la terre, par Jean Plana. Turin, 1858. 4to,—*From the Author.*

Abhandlungen der Köeniglich Bayerischen Akademie der Wissenshaften. Mathem.-Physikalischen Classe, achten Bandes, erste abtheilung. Philosoph. philologischen Classe, achten Bandes, erste und and zweite abtheil. Munchen, 1856. 4to.—*From the Bavarian Academy.*

Proceedings of the Zoological Society. Nos. 339–348. London, 8vo. —*From the Society.*

Gelehrte Anzeigen der K. Bayerischen Akademie der Wissenschaften. Bände 42–45. Munchen, 1856–57. 4to.—*From the Bavarian Academy.*

Comptes Rendus hebdomadaires des Séances de l'Academie des Sciences, par MM. les Secretaires perpetuels. Paris, 1857–8. —*From the Academy.*

Madras Journal of Literature and Science, edited by the Committee of the Madras Literary Society, and Auxiliary Royal Asiatic Society, Vols., I., II., and III., of New Series.—*From Dr Cleghorn, Madras.*

Monday, 1*st* *March* 1858.

Monday, 15*th* *March* 1858.

Monday, 5*th* *April* 1858.

Monday, 19*th* *April* 1858.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

SESSION 1858–59.

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